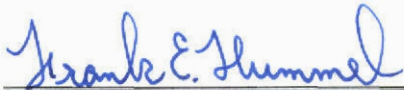


RAPORT
z odzyskania danych TAWS

**TAWS DATA EXTRACTION
FOR
NTSB IDENTIFICATION: ENG10SA025**

ORIGINAL

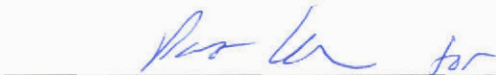
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Status
Original

Date
June 28, 2010

REVISION HISTORY

<u>Revision</u>	<u>Date</u>	<u>Name-Description</u>
Original	06/28/10	B. Ferguson-Baselined from preliminary TAWS report (StarTeam Revision 22).

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1 INTRODUCTION

This document summarizes the activities performed by Universal Avionics Systems Corporation (UASC) engineering personnel to extract data from a Terrain Awareness Warning System (TAWS) unit at the request of the National Transportation Safety Board (NTSB) in its investigation of an accident identified as ENG10SA025.

Bob Ferguson, Advanced Displays software manager, Ricardo Ardila, Advanced Displays systems manager, and Jim McCort, Engineering Services, performed the extraction procedures on May 4, 2010, at UASC's Redmond, Washington, facility. Chem Chaisy of Engineering Services made the central processing unit (CPU) board modification described in this report. Bob Ferguson and Ricardo Ardila analyzed the data and prepared this report.

2 REFERENCES

Table 2-1 Acronyms and Abbreviations

Acronym/Abbreviation	Description
ADC	air data computer
ARINC	Aeronautical Radio, Incorporated
CDU	control display unit
CPU	central processing unit
CRC	cyclic redundancy check
DTU	data transfer unit
EPU	estimated position uncertainty
FMS	Flight Management System (FMS)
GFX	graphics
GPS	global positioning system
ILS	instrument landing system
LRU	line replaceable unit
MCU	modular control unit
MFD	multifunction display
MSL	mean sea level
nm	nautical miles
NTSB	National Transportation Safety Board
NVM	nonvolatile memory
P/N	part number
PC	personal computer
RAM	random access memory
S/N	serial number
SCN	software control number
TAWS	Terrain Awareness Warning System
TOGA	take off go around
TRPA	terrain required position accuracy
UASC	Universal Avionics Systems Corporation
UTC	coordinated universal time
V	volts

3 SUMMARY OF ACTIVITIES

One UASC TAWS was recovered from the aircraft. TAWS is a 2 modular control unit (MCU) line-replaceable unit (LRU) that is normally mounted in the avionics bay. TAWS contains several computer boards. Its main CPU board runs the TAWS application software. The main CPU board contains a 32-kilobyte nonvolatile memory (NVM) device (U20), which is used to store such data as alerts, faults, and a copy of the TAWS configuration. The flash board contains the terrain and airport databases. The information requested by the NTSB resides on these boards. The other boards inside the TAWS do not retain any information after power is removed.

3.1 Preparation

Using information supplied by incident investigators about the software version of the installed TAWS, the TAWS engineers set up a rig and developed a procedure for extracting the nonvolatile memory contents from the TAWS.

The rig includes a Microsoft Windows PC, a known-good TAWS, a +28V power supply, a debugger probe, a data transfer unit (DTU), and a breakout box and wiring harness. A serial cable connects the Windows PC to the TAWS. The debugger probe connects to the CPU board and allows special software to be loaded and the contents of memory to be downloaded.

The procedure was developed to minimize the possibility of losing any information. First, the procedure calls for placing boards to be examined in the known-good TAWS. Placing the boards in a different host system reduces the chances that data will be lost or corrupted by electrical failures.

Second, prior to powering up the CPU board in the known-good TAWS, a modification to the board was developed to ensure that the contents of the U20 device could not be overwritten. The modification involved lifting the write-enable pin of the U20 device and connecting it to +5V through a pull-up resistor. Without the modification, there is some chance that the TAWS software would overwrite or erase the contents of the U20 device on power up.

Finally, the procedure extracts the data from the U20 by two methods. The first method extracts the entire binary image of the U20 device and decodes the image with a specially developed NVM parse tool. The second method uses the standard method of dumping formatted logs to disk. The first method results in data extraction with no loss of precision, while the second method provides a way to validate the results of the first method.

3.2 Data-Extraction Procedures

A Russian representative arrived with the TAWS, serial number 237, at the UASC Redmond facility on Tuesday, May 4, 2010, accompanied by Polish and NTSB representatives. With the representatives witnessing their actions, Bob Ferguson and Ricardo Ardila performed the extraction procedure. The specific steps of extraction are contained in APPENDIX B of this document.

3.2.1 Physical and Electrical Examination

The quality seals were not broken, meaning that the TAWS LRU had not been opened since the outgoing inspection. See Figure 3-1, Figure 3-2, Figure 3-3, and Figure 3-4 for photos of the exterior of the LRU and Figure 3-5, Figure 3-6, and Figure 3-7 for photos of the CPU board.

Table 3-1 TAWS Serial Number 237 Identification

Model	TAWS
Part Number	3010-00-00
Serial Number	237
Mod Level	1
TAWS Software	10.6
Bootstrap Software	10.6
ARINC Software	20.4
Analog Software	1.4
Airport SCN	0304
Terrain SCN	0209
Condition	Quality seal had damage. One side of the LRU had damage, and the metal side plate was pushed into the circuit board area of the LRU.



Figure 3-1 Label of TAWS Serial Number 237



Figure 3-2 Back Side of TAWS Serial Number 237 (Center of Photo)



Figure 3-3 Side View of TAWS Serial Number 237

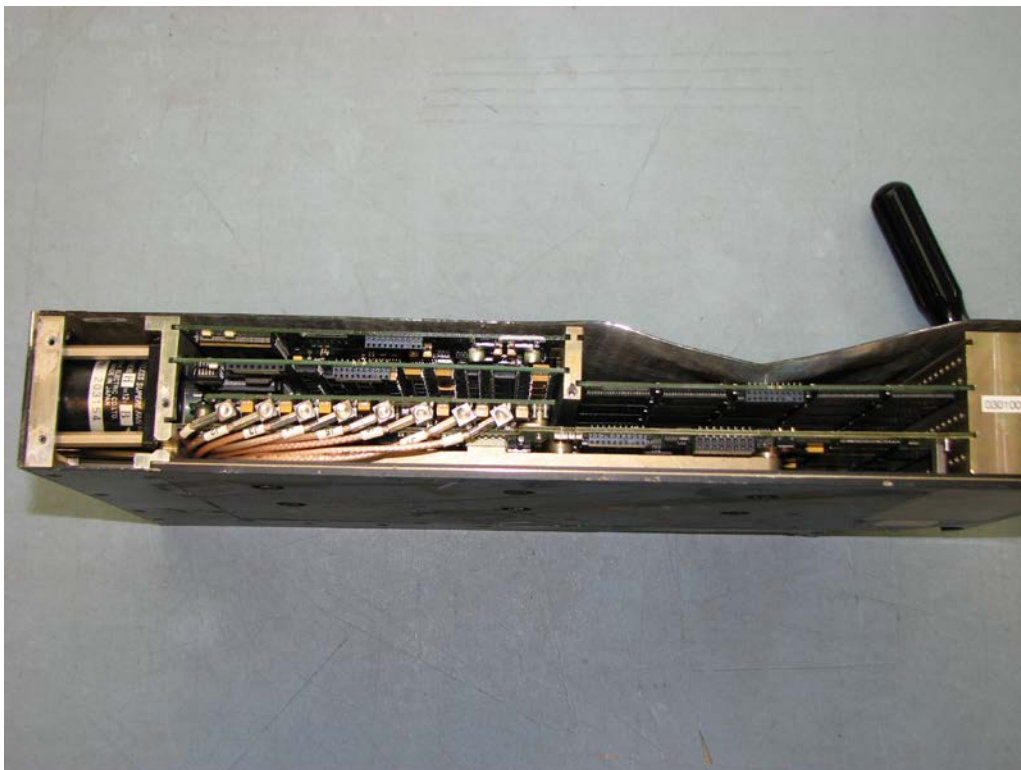


Figure 3-4 Top of TAWS Boards Serial Number 237

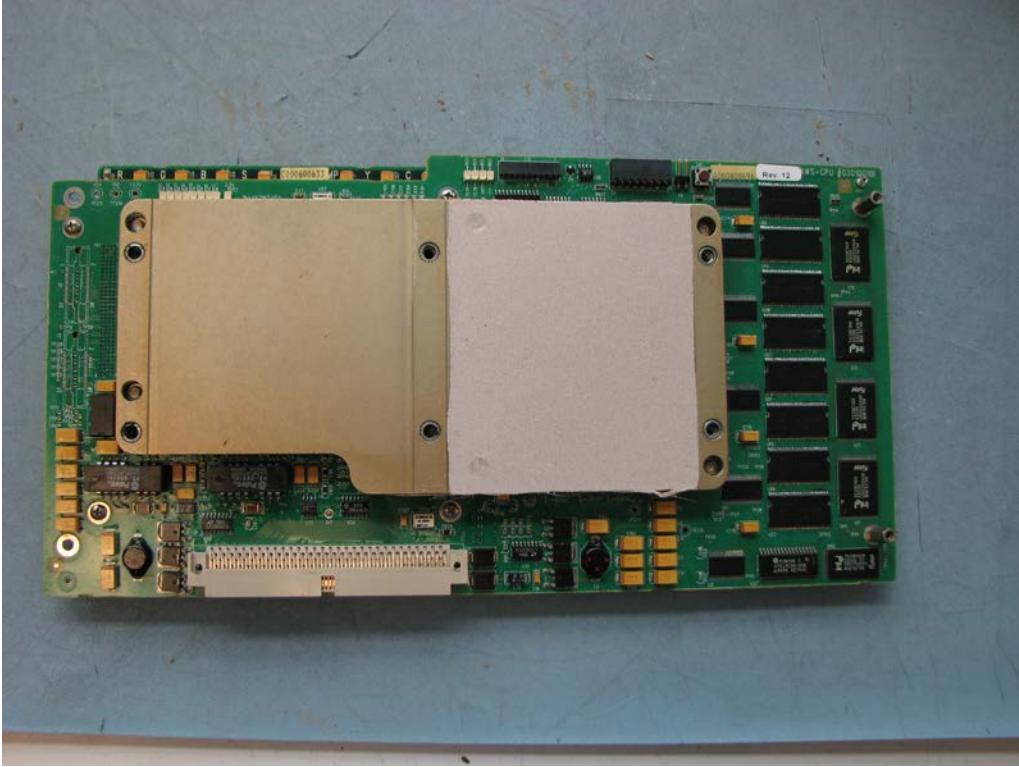


Figure 3-5 TAWS CPU before Modification Part Number 03010010

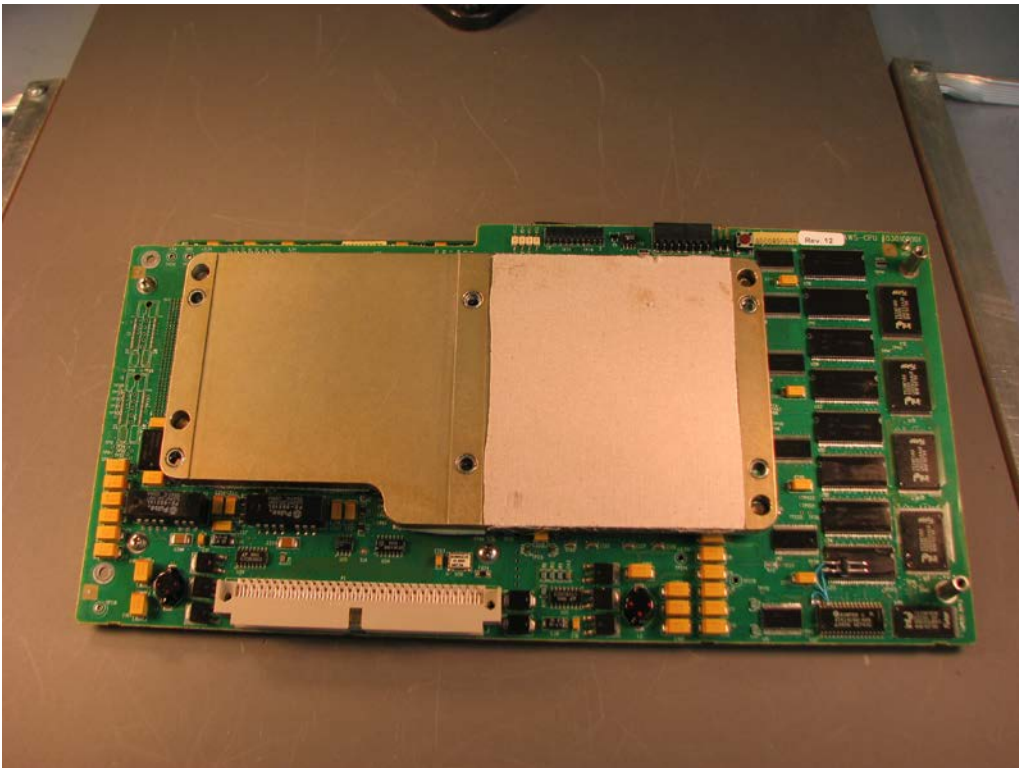


Figure 3-6 TAWS CPU after Modification Part Number 03010010

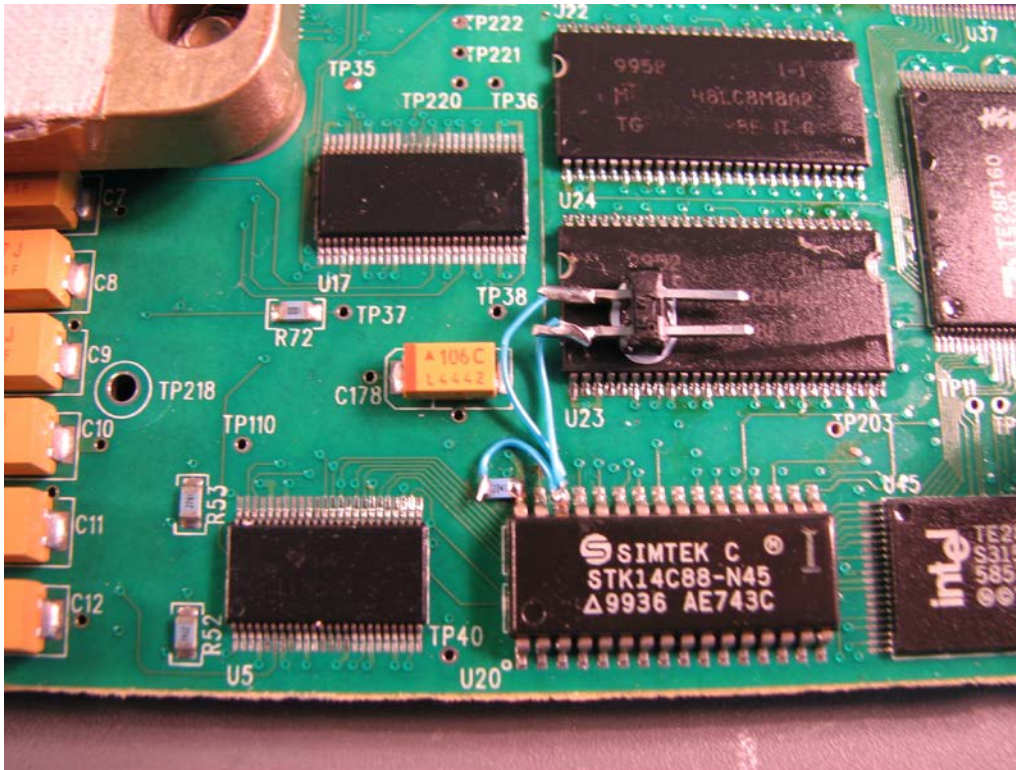


Figure 3-7 Close-up of CPU Board Modification to U20 Chip

The top cover of the unit was removed, and a visual examination of the components inside revealed no apparent damage to the boards. CPU board part number 03010010 was removed and examined thoroughly under a microscope. It did not appear to have any damage.

3.2.2 CPU Board NVM Extraction

This section summarizes the steps taken to conduct the data extraction. Refer to APPENDIX B for the complete procedure.

The CPU board was removed, and the U20 device was modified to prevent a possible overwrite of the chip contents. The modified CPU board was installed into the known-good TAWS LRU (referred to as the "golden unit" in APPENDIX B).

The first method for extraction was to use the debugger to read the contents of the U20 to a file. The system was powered for the first time without issue. The debugger was connected, and the contents of the U20 were read from memory and written to a file on the PC ("nvram.bin"). The file was examined using a hex editor and a specially developed NVM parse tool, and it was found to be valid. The output of the NVM parse tool is contained in the file "nvram.txt."

As a second method for data recovery, the normal method of dumping logs was performed. The dumped logs produce formatted output, which can be used as a way to cross-compare the output of the NVM parse tool. With the modifications to the U20, TAWS will fail an early built-in test. To get around this issue, a modified version of software (designated 10.6de) was executed via a debugger. Version 10.6de allows the system to operate despite the modifications to the U20. The

software (10.6de) was loaded and executed, and the TAWS logs and the contents of diagnostic page 26 (Miscellaneous Data) were downloaded to a Zip disk in a DTU and over the RS-232 port to the PC in ASCII format.

The TAWS logs extracted in this manner consist of the following files:

- TAWS_ALT.TXT – formatted alert log
- TAWS_FLT.TXT – formatted fault log
- TAWS_CFG.CFG – binary image of the configuration data
- TAWS_CFG.TXT – formatted report of the configuration data

Page 26 contains software and database versions. Only a subset of the data collected here was valid for the subject TAWS since only the CPU board from the subject unit was being examined.

The data-extraction process for the serial number 237 CPU board was successful. An initial cross-check between the binary file (nvram.bin) and the ASCII files (TAWS_ALT.TXT and TAWS_FLT.TXT) was also successful, and the data did not appear to be corrupted.

3.2.3 Flash Board Database Version Retrieval

The flash memory board was removed from the subject unit and appeared to be in reasonably good condition. However, upon installation into the known-good TAWS, the power-up built-in test of the flash board hardware failed.

The flash board was removed and inspected closely. Damage on flash chip U48 was observed, which was consistent with the placement of that chip on the board in relation to the damage to the outside of the LRU (refer to Figure 3-3 and Figure 3-4).

To get around the failure of the built-in test of the flash board hardware, a second modified version of SCN 10.6 was created (designated 10.6fb). The TAWS built-in test normally checks the manufacturer identification code for each of the 60 flash devices and declares failure when one device reports a bad code. Version 10.6fb simply reports the failed device but continues as if the failure had not occurred.

The modified software was loaded via the debugger and executed. It was observed that U48 was indeed the only failed device. Because U48 did not contain any of the information to be extracted (version numbers and dates), the information could be read from diagnostic page 26. This data was combined with the page 26 data captured earlier to create the file "versions.txt", containing information applicable to the subject unit as summarized below.

Table 3-2 TAWS Serial Number 237 Database and Software Versions

Item	Version or Value	Dates
Terrain Database	0209	04-Sep-2002 (Effective) 04-Sep-2002 (Build)
Airport Database	0304	17-Apr-2003 (Effective) 03-Apr-2003 (Build)

Item	Version or Value	Dates
Terrain Database CRC	0xC439223D	
Airport Database CRC	0xE13A4258	
CPU Boot	10.60	Aug 08 2002
CPU Boot CRC	0x0A4967D4	
Config Module	10_6_2	
GFX Filesystem	0012	14-Dec-2000

3.3 Conclusion of the Extraction Procedure

At the conclusion of the extraction procedure, copies of the raw data from serial number 237 were provided on memory sticks to the investigators. The TAWS unit was reassembled and returned to the investigators. UASC retained duplicate copies of the data files.

3.4 Analysis of TAWS Extracted Data

The extracted data consists of the following, which will be analyzed in subsequent sections of this report:

- Configuration Data
- Alert Logs
- Fault Logs
- Database Versions and Dates

3.4.1 Configuration Data

Based on the configuration data (APPENDIX E), the TAWS unit was configured to display the terrain images on the MFD-640 display. The TAWS was configured to receive position and other navigation data from the two installed UASC Flight Management System (FMS) units. Radio altitude was configured to be received from two analog PB-5M radio altimeters. A standard digital air data computer (ADC) was also configured, as was a digital instrument landing system (ILS) receiver.

The actual configuration of the aircraft is read by TAWS at power up from an external configuration module. The external configuration module was not available for data extraction. TAWS stores a copy of the contents of the external module in the U20 memory device. TAWS SCN 10.6 processes configuration data at power up as follows:

- Read and validate the NVM copy of the configuration data.
 - If this step fails, a fault is logged.
- Read and validate the external configuration module.
 - If successful, the contents of the external module are written to NVM.
 - If not successful, a fault is logged.
 - If the NVM copy of the configuration is valid, TAWS will use it.
 - If the NVM copy of the configuration is not valid, a fault is logged.

Since there are no faults in the Fault Log indicating any failures related to the configuration, it can be concluded that the extracted configuration represents the configuration of TAWS in the subject aircraft.

The configuration is stored and used by TAWS in binary format. The report (APPENDIX E) is created by TAWS. To verify the correctness of the human-readable report, the following additional steps were taken:

- The extracted binary configuration (TAWS_CFG.CFG) was compared to the corresponding memory locations in the U20 (nvram.bin) and found to be equivalent.
- The extracted binary configuration (TAWS_CFG.CFG) was loaded into a known-good TAWS in a lab environment, and the configuration in the report (TAWS_CFG.TXT, APPENDIX E) was verified to be correct.

3.4.2 Timeline

The alert logs recorded on April 10, 2010, included four time-stamped TAWS alerts, a takeoff, and a landing event. Various parameters such as aircraft state data and alert parameters were recorded for these events. Table 3-3 shows the timeline leading up to the last event recorded. The times are expressed in UTC on April 10, 2010. The full event logs are contained in APPENDIX C.

Table 3-3 Timeline of Events 33 through 38

Time (UTC)	Event #	Event	Notes
05:27:11	33	TAKEOFF	Ground-to-air transition. The recorded origin airport was EPWA.
06:40:03	34	ALERT ROC_CAUTION	FLTA (Forward Looking Terrain Alert) Caution alert event
06:40:29	35	ALERT ROC_CAUTION	FLTA (Forward Looking Terrain Alert) Caution alert event
06:40:36	36	ALERT ROC_WARNING	FLTA (Forward Looking Terrain Alert) Warning alert event recorded
06:40:43	37	ALERT ROC_WARNING	FLTA (Forward Looking Terrain Alert) Warning alert event
06:40:59	38	LANDING	Air-to-ground transition

3.4.3 Selected TAWS Alert Log Parameters

This section summarizes selected parameters from the TAWS Alert Log for the events of the timeline in Table 3-3. The data that follows is a subset of the full Alert Log output provided in APPENDIX C with additional notes provided where the meaning of the value may not be evident. Description of all parameters in the Alert Log is provided in APPENDIX A.

The subset summarized here was selected with input from all representatives and includes events logged on April 10, 2010. The parameters summarized include event name, event type, time stamp, aircraft location, aircraft altitude, configuration, and state of inhibits.

Table 3-4 indicates selected TAWS parameters from the Alert Log for event number 33 (takeoff event). Table 3-5 addresses the parameters in event numbers 34, 35, 36, and 37 (alerts). Table 3-6 addresses the parameters in event number 38 (landing event).

Table 3-4 Selected TAWS Parameters (Takeoff Event)

Event # 33		
Parameter	Value	Notes
Alert Record Type	TAKEOFF	Ground/Air transition event
Alert Date (M/D/Y)	04/10/2010	
Alert Time (H:M:S)	05:27:11	
Present Position Latitude	52.165796 deg	
Present Position Longitude	20.966862 deg	
Airplane Altitude	259.100424 ft	
Baro Altitude	259.000000 ft	
Radio Altitude	7.500000 ft	
Groundspeed	144.000000 kts	
True Airspeed	141.500000 kts	
Indicated Airspeed	144.375000 kts	
Flaps in Landing	0	Flaps not in landing position
Gear Down	1	Gear down
On Ground	0	In air

Table 3-5 Selected TAWS Parameters (ALERT Events)

Parameters Common to Events # 34, # 35, # 36, and # 37		
Parameter	Value	Notes
Alert Record Type	ALERT	
Alert Date (M/D/Y)	04/10/2010	
Inhibit	0xfe7ffff	Two alerts are inhibited: MODE_5_LOUD_GLIDE_SLOPE MODE_5_SOFT_GLIDE_SLOPE These alerts are inhibited automatically by TAWS unless the localizer is tuned and the localizer deviation is less than 2 dots.
Destination Airport	None	No destination airport was selected. TAWS will not select a destination airport that is not in its database.
Destination Runway	None	TAWS will not select a destination runway without a destination airport.
Flight Phase	APPROACH	
Flight Plan Adherence	0	
Flaps in Landing	1	Flaps in the landing position
Gear Down	1	Gear down
On Ground	0	In air
Glideslope Inhibit	0	Pilot had not selected glideslope inhibit
Decision Height Inhibit	0	Decision Height Inhibit was not configured or active
Flap Inhibit	0	Pilot had not selected flap inhibit
Terrain Inhibit	0	Pilot had not selected terrain inhibit
Inhibit All Modes	0	Pilot had not selected GPWS inhibit
Required Nav Precision	1.000000 nm	RNP received from FMS
Estimated Pos Uncertainty	0.100000 nm	EPU received from FMS
Terr Required Pos Accuracy	0.500000 nm	TRPA default for APPROACH mode
Curr Required Obs Clearance	100.000003 ft	ROC is the minimum vertical extent of the alert envelope. A value of 100 feet indicates that TAWS was in descent mode. During descent mode the vertical extents of the alerting envelope are expanded to account for pilot reaction distance and maneuver distance.
QFE Selected	0	
QFE Ref Airport	<null>	
QFE Mode Status	QFE_NOT_ACTIVE	TAWS was not operating in QFE mode

Event # 34		
Parameter	Value	Notes
Alert Time (H:M:S)	06:40:03	
Alert	ROC_CAUTION	
Alerts	0x00002000	The only active alert is ROC_CAUTION
Present Position Latitude	54.826754 deg	
Present Position Longitude	32.125595 deg	
Airplane Altitude	1080.053887 ft	
Baro Altitude	1080.000000 ft	
Radio Altitude	1159.312500 ft	
Sink Rate	-1440.873006 ft/min	
Closure Rate	-398.302534 ft/min	
Groundspeed	177.750000 kts	
True Airspeed	161.687500 kts	
Indicated Airspeed	160.812500 kts	
Maneuver Distance	36.913326 ft	Verified correct for current sink rate
Pilot Reaction Distance	48.029102 ft	Verified correct for current sink rate
Track Rate	0.067435 deg/sec	TAWS was using the straight alert envelope
Terr Conflict Latitude	54.825680 deg	Verified correct for the current position, altitude, track, groundspeed, EPU, ROC, maneuver distance, pilot reaction distance, and terrain database
Terr Conflict Longitude	32.099149 deg	
Terr Conflict Elevation	754.593200 ft	
Event # 35		
Parameter	Value	Notes
Alert Time (H:M:S)	06:40:29	
Alert	ROC_CAUTION	
Alerts	0x00002000	The only active alert is ROC_CAUTION
Present Position Latitude	54.825939 deg	
Present Position Longitude	32.091148 deg	
Airplane Altitude	1104.448535 ft	
Baro Altitude	1104.000000 ft	
Radio Altitude	699.250000 ft	
Sink Rate	-1335.726030 ft/min	
Closure Rate	-2335.895723 ft/min	
Groundspeed	157.625000 kts	
True Airspeed	148.500000 kts	
Indicated Airspeed	150.312500 kts	
Maneuver Distance	31.722437 ft	Verified correct for current sink rate
Pilot Reaction Distance	44.524202 ft	Verified correct for current sink rate
Track Rate	-0.035022 deg/sec	TAWS was using the straight alert envelope
Terr Conflict Latitude	54.825430 deg	Verified correct for the current position, altitude, track, groundspeed, EPU, ROC, maneuver distance, pilot reaction distance, and terrain database
Terr Conflict Longitude	32.066094 deg	
Terr Conflict Elevation	813.648320 ft	

Event # 36		
Parameter	Value	Notes
Alert Time (H:M:S)	06:40:36	
Alert	ROC_WARNING	
Alerts	0x00000020	The only active alert is ROC_WARNING
Present Position Latitude	54.825776 deg	
Present Position Longitude	32.082479 deg	
Airplane Altitude	933.464549 ft	
Baro Altitude	933.000000 ft	
Radio Altitude	425.562500 ft	
Sink Rate	-1513.345078 ft/min	
Closure Rate	-1606.621685 ft/min	
Groundspeed	156.125000 kts	
True Airspeed	149.000000 kts	
Indicated Airspeed	150.750000 kts	
Maneuver Distance	40.719994 ft	Verified correct for current sink rate
Pilot Reaction Distance	50.444838 ft	Verified correct for current sink rate
Track Rate	0.034652 deg/sec	TAWS was using the straight alert envelope
Terr Conflict Latitude	54.825639 deg	Verified correct for the current position, altitude, track, groundspeed, EPU, ROC, maneuver distance, pilot reaction distance, and terrain database
Terr Conflict Longitude	32.074702 deg	
Terr Conflict Elevation	754.593200 ft	
Event # 37		
Parameter	Value	Notes
Alert Time (H:M:S)	06:40:43	
Alert	TERRAIN_IMPACT_WARNING	
Alerts	0x00200040	There are two active alerts: TERRAIN_IMPACT_WARNING MODE_1_SINK_RATE
Present Position Latitude	54.825543 deg	
Present Position Longitude	32.073911 deg	
Airplane Altitude	751.679206 ft	
Baro Altitude	752.000000 ft	
Radio Altitude	323.250000 ft	
Sink Rate	-1505.013753 ft/min	
Closure Rate	187.173677 ft/min	
Groundspeed	154.750000 kts	
True Airspeed	144.312500 kts	
Indicated Airspeed	146.500000 kts	
Maneuver Distance	40.272882 ft	Verified correct for current sink rate
Pilot Reaction Distance	50.167127 ft	Verified correct for current sink rate
Track Rate	-0.190988 deg/sec	TAWS was using the straight alert envelope
Terr Conflict Latitude	54.825701 deg	Verified correct for the current position, altitude, track, groundspeed, EPU, ROC, maneuver distance, pilot reaction distance, and terrain database
Terr Conflict Longitude	32.079091 deg	
Terr Conflict Elevation	754.593200 ft	

Table 3-6 Selected TAWS Parameters (Landing Event)

Event # 38		
Parameter	Value	Notes
Alert Record Type	LANDING	Air-to-ground transition
Alert Date (M/D/Y)	04/10/2010	
Alert Time (H:M:S)	06:40:59	
Present Position Latitude	54.825022 deg	
Present Position Longitude	32.054838 deg	
Airplane Altitude	670.291288 ft	
Baro Altitude	671.000000 ft	
Radio Altitude	41.562500 ft	
Sink Rate	394.352188 ft/min	
Closure Rate	705.096987 ft/min	
Groundspeed	145.125000 kts	
True Airspeed	137.312500 kts	
Indicated Airspeed	139.437500 kts	
Flaps in Landing	1	Flaps in landing position
Gear Down	1	Gear down
On Ground	1	On ground

3.4.4 Fault Log

There were three fault records recorded for April 10, 2010. Refer to APPENDIX D.

3.4.5 Terrain and Airport Databases

The airport database was Version 0304, released in April 2003. The terrain database was Version 0209 released in September 2002.

4 CONCLUSION

The data extracted from the TAWS appeared to be intact. There was no indication that memory had been corrupted in the accident.

APPENDIX A TAWS ALERT LOG PARAMETERS

Table A-1 contains a more detailed description of parameters in the alert logs than what appears in other sections of this document.

Table A-1 Alert Log Parameter Description

Name	Description
Record CRC	<p>32-bit Cyclic Redundancy Checksum (CRC)</p> <p>The CRC is computed over all the bytes in the alert record except the CRC itself.</p>
Record Size	<p>Size of the alert record (number of bytes).</p> <p>The size of each alert record for SCN 10.6 is 72 bytes.</p>
Alert Record Type	<p>Three types of records are logged in the alert log:</p> <ul style="list-style-type: none"> • ALERT • LANDING • TAKEOFF <p>TAKEOFF records are logged on ground-to-air transitions. LANDING records are logged on air-to-ground transitions.</p> <p>For TAKEOFF and LANDING records, the following parameters are always set to zero and must be considered as invalid:</p> <ul style="list-style-type: none"> • Alert = 0 (RWS_WARNING) • Alerts = 0 (no alerts) • Inhibits = 0 (all inhibits) <p>ALERT records are logged only when the current highest priority active alert is different from the previous highest priority active alert.</p> <p>For all alerts summarized in this report, the parameters reflect the state of the system at the time the alert is logged.</p>
Alert Date (M/D/Y)	<p>Source-selected UTC date.</p> <p>For this configuration, the source of this parameter in order of priority is:</p> <ol style="list-style-type: none"> 1. PRIMARY FMS (L260) 2. SECONDARY FMS (L260) <p>In the absence of UTC date from the FMS, internal timing is used to track the date. If internal timing has not been initialized, TAWS uses a default date of 01/01/1993.</p>
Alert Time (H:M:S)	<p>Source-selected UTC time.</p> <p>For this configuration, the source of this parameter in order of priority is:</p> <ol style="list-style-type: none"> 1. PRIMARY FMS (L150) 2. SECONDARY FMS (L150) <p>In the absence of UTC time from the FMS, internal timing is used to track the time. If internal timing has not been initialized, TAWS uses a default time of 12:00:00.</p>
SCN Version	<p>Major version portion of the software control number (SCN).</p> <p>Extracted directly from the SCN string embedded within the TAWS software.</p> <p>10 for SCN 10.6.</p>

Name	Description
SCN Revision	<p>Minor version portion of the SCN.</p> <p>Extracted directly from the SCN string embedded within the TAWs software.</p> <p>6 for SCN 10.6.</p>
Alert	<p>The highest priority active alert. This is the alert that TAWs begins to annunciate at the time the alert is logged.</p> <p>Refer to Table A-2 for a list of possible alerts sorted by priority.</p>
Alerts	<p>All active alerts. A 32-bit value containing one bit for each active alert. Bit values of 1 indicate an active alert.</p> <p>Refer to Table A-2 for the bit values and corresponding alert.</p>
Inhibits	<p>All active inhibits. A 32-bit value containing one bit for each inhibit. Bit values of 0 indicate an active inhibit. A value of FFFFFFFF indicates that no alerts are inhibited.</p> <p>Refer to Table A-2 for the bit values and corresponding inhibit.</p>
Tail Number	<p>Aircraft tail number.</p> <p>The tail number is entered as part of the configuration during system installation. The tail number in the alert log is extracted directly from the configuration data that has been read and validated by TAWs at power up.</p>
From Leg	<p>Not used in SCN 10.6. The From Leg field is hard-coded to "???".</p>
To Waypoint	<p>Identifier of the TO waypoint.</p> <p>Received from the FMS. The FMS transmits the TO waypoint identifier in words 4, 5, and 6 of the active flight plan block data transfer (L232).</p>
Origin Airport	<p>Identifier of the departure airport.</p> <p>The origin airport is the airport in the TAWs airport database closest to the aircraft position at the time of ground-to-air transition.</p>
Origin Runway	<p>Identifier of the departure end of the runway of takeoff.</p> <p>The origin runway is selected from all of the thresholds at the origin airport that have a bearing within 15 degrees of 180 degrees plus aircraft track. If no runways satisfy this condition, the origin is "None".</p> <p>TAWs selects between parallel runways that satisfy the 15-degree limit by finding the threshold for which the line extended (either direction) through the threshold and the aircraft position is most parallel with the runway center line.</p>
Destination Airport	<p>Identifier of the destination airport.</p> <p>If the FMS flight plan has a destination airport that is in the TAWs airport database, TAWs will select the destination airport when within 15 nm and at or below 6,500 feet above field elevation.</p>
Destination Runway	<p>Identifier of the destination runway.</p> <p>If TAWs has a destination airport, it will select the destination runway at that airport using the destination runway from the FMS flight plan, flight plan adherence, and additional logic based on proximity and geometry.</p>

Name	Description
Flight Phase	<p>The flight phase as computed by TAWS. There are four possible flight phases:</p> <ul style="list-style-type: none"> • DEPARTURE • ENROUTE • TERMINAL • APPROACH <p>The flight phase takes into account flap inputs, localizer/glideslope values, TOGA state, position relative to origin or destination.</p> <p>The APPROACH flight phase is entered under any one of the following conditions:</p> <ul style="list-style-type: none"> • Flaps In Landing input is true • Flap Inhibit is true • Precision approach (localizer tuned and localizer deviation less than 2 dots, glideslope deviation valid and less than 2 dots) • Destination is valid and within 5 nm and 3,000 feet of destination
Flight Plan Adherence	<p>Flight plan adherence is a determination by TAWS that the FMS is following the flight plan. Flight plan adherence is false by default. To be true, it requires a number of conditions to be met, at a minimum:</p> <ul style="list-style-type: none"> • Flight plan must be entered • FMS must indicate that there is a TO leg • FMS must indicate that there is a FROM waypoint that is not a GAP • Cross Track Distance received from the FMS must be valid (Label 116) • Track Angle Error received from the FMS must be valid (Label 005) • The FMS must not be indicating that selected cross track mode is active <p>If the required inputs are valid, the flight plan adherence will be considered true if the Cross Track + Estimated Position Uncertainty (EPU) is at or below Terrain Required Position Accuracy (TRPA).</p> <p>If the above conditions are still not met, TAWS determines flight plan adherence for the special case where the FMS is sequencing a leg and commands a turn. The turning logic considers many inputs.</p>
Present Position Latitude	<p>Latitude of the current aircraft position, in degrees.</p> <p>For this configuration, the source of this parameter in order of priority is:</p> <ol style="list-style-type: none"> 1. PRIMARY FMS (L310 and L340) 2. SECONDARY FMS (L310 and L340) <p>The position is derived by combining coarse and fine latitude labels (L310 and L340).</p>
Present Position Longitude	<p>Longitude of the current aircraft position, in degrees.</p> <p>For this configuration, the source of this parameter in order of priority is:</p> <ol style="list-style-type: none"> 1. PRIMARY FMS (L311 and L341) 2. SECONDARY FMS (L311 and L341) <p>The position is derived by combining coarse and fine longitude labels (L311 and L341).</p>

Name	Description
Airplane Altitude	<p>Altitude used for alerts, in feet.</p> <p>During non-QFE operations, TAWS derives airplane altitude from both baro-corrected and uncorrected pressure altitude. TAWS computes a filtered baro correction value by filtering the difference between baro-corrected and pressure altitude inputs. Airplane altitude is computed as the uncorrected pressure altitude input with the filtered baro-correction added. Thus, during non-QFE operations, airplane altitude can be expected to lag the baro-corrected input slightly.</p> <p>During QFE operations, TAWS will perform additional processing on the baro-corrected altitude input to adjust it for QNH.</p>
Baro Altitude	<p>Baro-corrected pressure altitude input, in feet.</p> <p>Value of the source-selected baro-corrected pressure altitude input.</p> <p>For this configuration, the source of this parameter in order of priority is:</p> <ol style="list-style-type: none"> 1. ADC (L204) 2. PRIMARY FMS (L204) 3. SECONDARY FMS (L204)
Radio Altitude	<p>Filtered radio altimeter, in feet.</p> <p>For this configuration, the sources of Radio Altitude are analog inputs.</p> <p>For analog Radio Altitude, the analog inputs are invalidated for values greater than the configured maximum (2,500 feet). The analog inputs are sampled every 10 milliseconds. The filtered radio altitude is computed every 100 milliseconds.</p> <p>When both radio altitude inputs are valid, the filtered inputs are averaged.</p>
Sink Rate	<p>Computed vertical speed, in feet/minute.</p> <p>TAWS computes vertical speed based on available inputs in this order of priority:</p> <ol style="list-style-type: none"> 1. Filtered vertical speed (L212) from the selected ADC 2. Filtered rate of change of baro-corrected altitude (L204) from the selected ADC <p>For this configuration, the source of air data parameters in order of priority is:</p> <ol style="list-style-type: none"> 1. ADC 2. PRIMARY FMS 3. SECONDARY FMS
Selected Altitude	<p>Selected altitude, in feet.</p> <p>For this configuration, the source of this parameter in order of priority is:</p> <ol style="list-style-type: none"> 1. ADC (L102) 2. PRIMARY FMS (L102) 3. SECONDARY FMS (L102) <p>TAWS does not use Selected Altitude in SCN 10.6.</p>
Closure Rate	<p>Computed rate of change of radio altitude, in feet/minute.</p> <p>Closure rate is computed as a filtered rate of change for each radio altimeter input. For airspeeds greater than 178 knots, closure rate is increased as a function of speed.</p> <p>If both radio altimeter inputs are valid, the computed closure rate is the average of both rates.</p>

Name	Description
Groundspeed	<p>Groundspeed, in knots.</p> <p>Groundspeed is selected from the same source that provides position data.</p> <p>For this configuration, the source of this parameter in order of priority is:</p> <ol style="list-style-type: none"> 1. PRIMARY FMS (L312) 2. SECONDARY FMS (L312)
True Airspeed	<p>True airspeed, in knots.</p> <p>For this configuration, the source of this parameter in order of priority is:</p> <ol style="list-style-type: none"> 1. ADC (L210) 2. PRIMARY FMS (L210) 3. SECONDARY FMS (L210)
Indicated Airspeed	<p>Indicated airspeed, in knots.</p> <p>For this configuration, the source of this parameter in order of priority is:</p> <ol style="list-style-type: none"> 1. ADC (L206) 2. PRIMARY FMS (L206) 3. SECONDARY FMS (L206)
Flaps in Landing	<p>State of flaps-in-landing discrete input.</p> <p>"FLAPS" or 1 indicates discrete is asserted. "NO FLAPS" or 0 otherwise.</p>
Gear Down	<p>State of gear down discrete input.</p> <p>"DOWN" or 1 indicates discrete is asserted. "UP" or 0 otherwise.</p>
On Ground	<p>Filtered air/ground discrete input.</p> <p>"GROUND" or 1 indicates discrete is asserted and TAWS has declared the aircraft to be on the ground. "AIR" or 0 indicates TAWS considers the aircraft to be in the air.</p>
Glideslope Inhibit	<p>State of TAWS internal glideslope inhibit.</p> <p>TAWS determines glideslope inhibit by monitoring transitions of the glideslope inhibit input discrete (a momentary type).</p> <p>When the discrete is asserted momentarily and radio altitude is at or below 2,000 feet, glideslope inhibit is considered true.</p> <p>When the discrete is asserted momentarily again, or radio altitude exceeds 2,100 feet, glideslope inhibit is considered false.</p> <p>When inhibited, ground proximity Mode 5 alerts are suppressed from annunciation.</p>
Decision Height Inhibit	<p>The decision height inhibit input is not used in SCN 10.6. It cannot be configured, and TAWS will not accept any configuration with it enabled.</p> <p>Decision height inhibit will always be 0, indicating not inhibited.</p>

Name	Description
Flap Inhibit	<p>State of flap inhibit discrete input.</p> <p>"INHIBIT" or 1 indicates discrete is asserted. "NO INHIBIT" or 0 otherwise.</p> <p>When inhibited, ground proximity Mode 4B alerts are suppressed from annunciation.</p>
Terrain Inhibit	<p>State of terrain inhibit discrete input.</p> <p>"INHIBIT" or 1 indicates discrete is asserted. "NO INHIBIT" or 0 otherwise.</p> <p>When inhibited, forward-looking terrain alerts are suppressed from annunciation.</p>
Master Audio Cancel	<p>State of the master audio cancel discrete input.</p> <p>When configured, master audio cancel provides a means to suppress the aural annunciation for the currently active alert.</p> <p>Master audio cancel was not configured for this aircraft.</p>
Inhibit All Modes	<p>State of GPWS modes inhibit input discrete.</p> <p>"INHIBIT" or 1 indicates discrete is asserted. "NO INHIBIT" or 0 otherwise.</p> <p>When inhibited, ground proximity alerts (Modes 1 through 6) are suppressed from annunciation.</p>
Takeoff/Go-around	<p>Takeoff/Go-around mode.</p> <p>Computed by TAWS. Takeoff/Go-around mode takes into account air/ground input, gear input, sink rate, radio altitude, go-around indication from FMS (active leg), and TOGA discrete input.</p>
Backcourse Approach	<p>State of either backcourse approach input discrete.</p> <p>When configured, the backcourse discrete inputs are used to inhibit glideslope alerts on backcourse approaches.</p> <p>The backcourse approach discrettes were not configured for this aircraft.</p>
Required Nav Precision	<p>Required Navigation Precision (RNP), in nautical miles.</p> <p>RNP is received from the FMS (L230). If RNP is valid and less than Terrain Required Position Accuracy (TRPA), it is used for alert algorithms in place of TRPA. Refer to Terr Required Pos Accuracy for more.</p>
Estimated Pos Uncertainty	<p>Estimated Position Uncertainty (EPU), in nautical miles.</p> <p>EPU is computed or selected based on the source of position data and represents the uncertainty in the position. For this configuration, EPU is selected from the primary or secondary FMS (L231).</p> <p>EPU is used in the size of the envelope used for alerting. The envelope width is 1.8 times EPU and it extends 1.8 times EPU behind the current position. The forward extent of the envelope is 4 times EPU plus a look-ahead distance (groundspeed times 60, 90, or 120 seconds).</p>

Name	Description
Terr Required Pos Accuracy	<p>Terrain Required Position Accuracy (TRPA), in nautical miles.</p> <p>If Estimated Position Uncertainty (EPU) exceeds TRPA the terrain alerts are inoperative. This is annunciated via the TERR INOP lamp and the "Terrain Position Unavailable" message on the TAWS display.</p> <p>The default TRPA is based on flight phase. For the APPROACH phase of flight, the default TRPA is 0.5 nautical miles. If Required Navigation Precision (RNP) is smaller, it will be used in place of TRPA.</p>
Maneuver Distance	<p>Maneuver distance, in feet.</p> <p>The maneuver distance is $0.21 * (\text{Sink Rate})^2$, where Sink Rate is in meters per second. Maneuver distance constrains the level-off acceleration to a maximum allowed G value for the current vertical speed.</p> <p>Maneuver distance is used to expand the vertical extent of the alert envelope during descent.</p>
Pilot Reaction Distance	<p>Pilot reaction distance, in feet.</p> <p>The pilot reaction distance is Pilot Reaction Time * Sink Rate, where Pilot Reaction Time depends on flight phase. During approach, Pilot Reaction Time is 2 seconds.</p> <p>Pilot reaction distance is used to expand the vertical extent of the alert envelope during descent.</p>
Curr Required Obs Clearance	<p>Active Required Obstacle Clearance (ROC), in feet.</p> <p>The ROC depends on flight phase and whether the aircraft is in descent. During the approach phase of flight ROC is 100 feet for descent and 150 feet for level flight. Descent is triggered by a sink rate of more than 500 feet per minute. Once triggered, descent mode continues until sink rate reaches 0 feet per minute.</p> <p>ROC is used as the basic vertical extent of the alert envelope during level flight and descent. During descent the maneuver distance and pilot reaction distance are added to ROC to expand the vertical envelope.</p>
Glideslope Deviation	<p>Glideslope deviation, in dots.</p> <p>For this configuration the source for glideslope deviation is the low-speed digital ILS receiver (L174).</p>
Localizer Deviation	<p>Localizer deviation, in dots.</p> <p>For this configuration the source for localizer deviation is the low-speed digital ILS receiver (L173).</p>
Localizer Tuned	<p>Status of localizer tuned.</p> <p>"TRUE" or 1 indicates localizer is tuned. "FALSE" or 0 otherwise.</p> <p>TAWS derives the Localizer Tuned status from various inputs from the ILS receiver. For this configuration, the Localizer Tuned state is determined from the state of the ILS Mode input discrete, or from the ILS frequency (L033) being valid and between 108000.0 and 112000.0.</p>
ILS Mode	<p>State of either ILS Mode input discrete.</p> <p>1 indicates either ILS Mode 1 discrete or ILS Mode 2 discrete is asserted. TF indicates ILS Mode 1 discrete was asserted and ILS Mode 2 discrete was not. FF indicates neither ILS Mode discrete was asserted.</p>

Name	Description
True Track	<p>True track angle, in degrees.</p> <p>True track is selected from the same source that provides position data.</p> <p>For this configuration, the source of this parameter in order of priority is:</p> <ol style="list-style-type: none"> 1. PRIMARY FMS (L313) 2. SECONDARY FMS (L313)
Track Rate	<p>Computed rate of change of true track, in degrees/sec.</p> <p>Track rate is used to determine if the aircraft is turning. For track rates with magnitude less than 1 degrees/second, TAWS uses a straight, nearly rectangular alert envelope.</p>
Cross Track	<p>Lateral distance from the FMS flight plan, in nautical miles.</p> <p>The source of this parameter in order of priority is:</p> <ol style="list-style-type: none"> 1. PRIMARY FMS (L116) 2. SECONDARY FMS (L116)
Terr Conflict Latitude	<p>Latitude of the terrain cell associated with the logged alert, in degrees.</p> <p>The alert algorithm examines the terrain cells contained within the lateral boundaries of the alert envelope. The lateral boundaries of the alert envelope depend on present position, EPU, track, groundspeed and look-ahead time.</p> <p>When the elevation of a terrain cell penetrates the floor of the alert envelope, an alert is generated. The algorithm examines cells beginning from the back of the envelope and proceeding forward. The back of the envelope extends behind the current aircraft position to account for position uncertainty.</p>
Terr Conflict Longitude	<p>Longitude of the terrain cell associated with the logged alert, in degrees.</p> <p>Refer to Terr Conflict Latitude for more description.</p>
Terr Conflict Elevation	<p>Elevation of the terrain cell associated with the logged alert, in degrees.</p> <p>Refer to Terr Conflict Latitude for more description.</p>
Roll Angle	<p>Filtered roll angle, in degrees.</p> <p>TAWS filters the roll angle input for use in the bank angle limit alert. Bank angle limit is a configurable alert, which was not configured in this aircraft.</p> <p>For this configuration, the source of the input to the filter in order of priority is:</p> <ol style="list-style-type: none"> 1. PRIMARY FMS (L325) 2. SECONDARY FMS (L325)
Nav Frequency	<p>The tuned ILS or VOR frequency.</p> <p>For this configuration, the source of the input is the ILS receiver.</p>
QFE Selected	<p>Reflects a request for QFE mode.</p> <p>"SELECTED" or 1 indicates QFE mode was requested. "NOT SEL'D" or 0 otherwise.</p> <p>The QFE Mode Status indicates the actual state of TAWS QFE operation.</p>

Name	Description
QFE Ref Airport	<p>QFE reference airport.</p> <p>While the QFE Mode function is active, the selected origin or destination airport is referenced to an elevation of 0 feet instead of MSL. This airport is called the QFE Reference Airport. For an airport to become the QFE reference airport, it must be in the airport database.</p>
QFE Mode Status	<p>Operational status of QFE mode.</p> <p>Status of NOT ACTIVE indicates QFE mode has not been selected. Status of ACTIVE indicates QFE mode is operational. Any other status indicates QFE mode has been selected but the conditions for activation of QFE cannot be met.</p> <p>The complete list of possible QFE Mode Status values is:</p> <ul style="list-style-type: none"> • NOT ACTIVE • ACTIVE • NO DEPART AIRPORT • NO ARRIVAL AIRPORT • TERR INOP • TERR INHIBIT • ABOVE TRANSITION ALT • NOT IN DEPART TERM AREA • PRESSURE ALT FAIL • BARO COMP CHANGED • BARO ALT FAIL • ARRIVAL AIRPORT CHANGED
MSL Altitude	<p>When configured for WGS84 GPS datum, the MSL altitude is computed as: $MSL\ Altitude = GPS\ Altitude + Geoidal\ Separation$</p> <p>The source of GPS Altitude for this configuration is the FMS (primary or secondary). The Geoidal Separation is calculated internally via a built-in model.</p> <p>TAWS does not use MSL Altitude in SCN 10.6.</p>

Table A-2 lists all alert types that the UASC TAWS can generate. The list is sorted in decreasing order of alert priority. The identifiers (1, 2A, etc.) in the Alert Description fields refer to GPWS modes 1 through 7. The Bit Number indicates the corresponding bit in the Alerts and Inhibits words of the Alert Log, where bit zero is the least significant (right-most) bit.

Table A-2 TAWS Alerts (Ordered by Priority)

Alert Name	Alert Description	Bit Number
RWS_WARNING	WARNING: Reactive Windshear Warning (7)	0
MODE_1_PULL_UP	WARNING: Pull Up (1)	1
MODE_2A_PULL_UP	WARNING: Pull Up (2A)	2
MODE_2A_TERRAIN_WARNING_PREFACE	WARNING: Terrain (2A)	3
HIGH_TERRAIN_IMPACT_WARNING	WARNING: Terrain Ahead Pull Up	4
ROC_WARNING	WARNING: Terrain Ahead Pull Up	5
TERRAIN_IMPACT_WARNING	WARNING: Terrain Ahead Pull Up	6
PWS_WARNING	WARNING: Predictive Windshear	7
MODE_2B_PULL_UP	WARNING: Pull Up (2B)	8
MODE_2A_TERRAIN	CAUTION: Terrain Terrain (2A)	9

Alert Name	Alert Description	Bit Number
MODE_2B_TERRAIN	CAUTION: Terrain Terrain (2B)	10
MODE_6_ALTITUDE_CALLOUTS_MIN	INFORMATIONAL: Minimums (6)	11
HIGH_TERRAIN_IMPACT_CAUTION	CAUTION: Terrain	12
ROC_CAUTION	CAUTION: Terrain	13
TERRAIN_IMPACT_CAUTION	CAUTION: Terrain	14
MODE_4_TERRAIN	CAUTION: Too Low Terrain (4)	15
MGCB_ALERT	CAUTION: Terrain Clearance Plane	16
MODE_6_ALTITUDE_CALLOUT_500	INFORMATIONAL: Altitude Callouts (6)	17
MODE_6_ALTITUDE_CALLOUT	INFORMATIONAL: Altitude Callouts (6)	18
MODE_4A_GEAR	CAUTION: Too Low Gear (4A)	19
MODE_4B_FLAPS	CAUTION: Too Low Flaps (4B)	20
MODE_1_SINK_RATE	CAUTION: Sink Rate (1)	21
MODE_3_DONT_SINK	CAUTION: Sink Rate	22
MODE_5_LOUD_GLIDE_SLOPE	CAUTION: (Hard) Glideslope (5)	23
MODE_5_SOFT_GLIDE_SLOPE	CAUTION: (Soft) Glideslope (5)	24
PWS_CAUTION	CAUTION: Predictive Windshear Caution	25
MODE_6_ALTITUDE_CALLOUT_APPROACH	INFORMATIONAL: Approaching Minimums (6)	26
MODE_6_BANK_ANGLE	CAUTION: Bank Angle (6)	27
FLIGHT_PLAN_THROUGH_TERRAIN_ADVISORY	ADVISORY: Check Flight Plan Terrain	28
MSA_ADVISORY	ADVISORY: Below MSA	29
CHECK_ALTITUDE	ADVISORY: Altimeter Setting	30

APPENDIX B TAWS DATA-EXTRACTION PROCEDURE

Checklist for Extracting Data from TAWS NVRAM (SCN 10.6)

May 07, 2010

Verify Lab Bench Setup

1. The PC should have the following:
 - SDS debugger / probe
 - Hyperterm configured for TAWS monitor program
2. A golden unit (S/N 222) should be installed in rack with breakout box.
3. A grounded anti-static mat is available for unit disassembly.

Remove CPU/Video Board Assembly from the Customer TAWS

4. Closely examine the physical condition of the Customer TAWS unit. Note any damage, etc. Note condition of seals.
5. Put on a grounding strap.
6. Remove the top and side panels. Note any obvious damage inside.
7. Remove the CPU/Video Board Assembly (PN 00301010).

Rework the CPU Board

This rework will disable the write enable line to the NVRAM device unless a jumper is installed (Write Enable Jumper).

8. Examine the CPU board for any damage. If the CPU board has obvious damage that will prevent it from powering up then conduct the steps in section "Replace U20 on Golden Unit with Customer U20" then continue with step 9.
9. Conduct rework per attached instructions. The rework will render the NVRAM device to be read-only unless the Write Enable Jumper is installed.
10. Install a debug connector if necessary.

Install CPU/Video Board Assembly into Golden Unit

11. Make sure power is off.
12. Put on a grounding strap.
13. Install the CPU/Video Board Assembly from customer's TAWS into golden unit.

14. Make sure the Write Enable Jumper is **not** installed.
15. Measure no continuity between U20 pin 30 and the write enable leg of the jumper.
Measure continuity between U20 pin 30 and the other leg of the jumper.
16. Measure 2.74K ohm between U20 pin 30 and U20 pin 32.

Extract NVRAM Contents via Debugger

17. Verify power is off.
18. Install the golden unit in the rack.
19. Make sure the Write Enable Jumper is **not** installed.
20. Make sure there is no external configuration module connected.
21. Connect the Watchdog Jumper.
22. Start Hyperterm and open TAWS.ht.
23. Verify connection between COM1 and the breakout box.
24. Turn **on** capture mode to log output from the unit.
25. Turn power on.
26. Wait for the boot software to stop (NVRAM failure).
27. Connect the debugger probe and establish a debug session (debug without file).
28. Execute the following command from the SDS command prompt:
upload 0xffe00000,32k nvram.bin
29. Use the *pwd* SDS command to locate the .bin file.
30. Move the .bin file to locations C:\TAWS_10_6

Dump the NVRAM Logs with RAM software

This procedure uses a RAM build of SCN 10.6 (SCN 10.6de) which ignores the failure to write NVRAM.

31. Make sure the Write Enable Jumper is **not** installed.
32. Load the modified TAWS 10.6 software with the debugger (SCN 10.6de).
33. Start the application with the debugger.

34. Make sure the version field shows 10.6de.
35. Put a blank Zip disk into the DTU.
36. Navigate to page 30 and dump the logs.
37. Navigate to page 26 (Misc Data) and copy the contents of this page to file
C:\TAWS_10_6\misc_data.txt.

Note: Only the following fields on the Misc Data page are applicable to the Customer's
TAWS:

- CPU Boot Version and Date
- Config Module Version
- GFX File System Version and Date
- CPU Boot CRC
- MAC Address
- IP Address

38. Stop the debugger.
39. Stop Hypterterm capture mode.
40. Remove the Zip disk from the DTU.
41. Turn power off.
42. Move the Zip disk files to locations C:\TAWS_10_6.
43. Copy all collected data to a network location (U: drive).

Check the validity of the Collected Data

44. Use HexWorkshop program to examine the *nvr.am.bin* file for validity.
45. Parse the .bin file with *nvmparse.exe*
nvmparse nvr.am.bin
46. Examine the *nvr.am.txt* file for validity and agreement with the dumped logs
(TAWS_ALT.txt and TAWS_FLT.txt).

Capture Database Information from Customer Flash Board

The following steps will extract the versions, dates, and CRC's of the terrain and airport
databases from the Customer's flash board.

47. Reinstall the golden unit CPU/Video board assembly.
48. Remove the flash board from the golden unit.

49. Tag or mark the golden unit flash board to distinguish it from the flash board from the customer's unit.
50. Put on a grounding strap.
51. Remove the flash board from the customer's TAWS.
52. Inspect the customer's flash board for damage.
53. Install customer's flash board into the golden unit.
54. Verify power is off.
55. Install the golden unit in the rack.
56. Start Hyperterm and open TAWS.ht.
57. Verify connection between COM1 and the breakout box.
58. Turn power on.
59. Navigate to page 26 (Misc Data) and copy the contents of this page to file C:\TAWS_10_6\misc_data2.txt.

Note: Only the following fields on the Misc Data page are applicable to the Customer's TAWS:

- Terrain DB Version, Effective Date, and Build Date
- Airport DB Version, Effective Date, and Build Date
- Terrain DB CRC
- Airport DB CRC

60. Turn power off.
61. Create new text file named versions.txt with the following text:
This file contains only data which is applicable to the subject TAWS unit. The data were captured from the TAWS Misc Data pages (page 26) using (1) the CPU board from the subject unit (misc_data.txt) and (2) the flash memory board from the subject unit (misc_data2.txt).
62. Copy the fields applicable to the customer's TAWS captured in step 37 from misc_data.txt to versions.txt.
63. Copy the fields applicable to the customer's TAWS captured in step 59 from misc_data2.txt to versions.txt.
64. Copy newly collected data to a network location (U: drive).
65. Restore the configuration of the customer's TAWS.

Replace U20 on Golden Unit with Customer U20

The following steps are only required if the previous two data extraction methods did not work or the board is in a condition where applying power is not possible.

66. Remove the CPU/Video Board Assembly from the customer's TAWS.
67. Remove U20 from the CPU board (Customer U20).
68. Remove U20 from the Golden unit CPU board.
69. Install Customer U20 on the golden unit CPU board.
70. Run the procedures beginning with section "Rework the CPU Board" up to this section using the golden CPU board with the Customer U20.

Capture Database Information from Customer Flash Board with Failed Flash

The following steps were added after a failure at step 59. Damage was observed on flash memory device U48. These steps will execute modified TAWS software via the debugger. The modified software will report but ignore all flash memory device failures. This should allow capturing the database versions, dates, and CRCs from page 26 assuming the failure is isolated to U48.

71. Install the customer flash board into the golden unit.
72. Verify power is off.
73. Install the golden unit in the rack.
74. Connect the Watchdog Jumper.
75. Start Hyperterm and open TAWS.ht.
76. Turn **on** capture mode to log output from the unit.
77. Verify connection between COM1 and the breakout box.
78. Turn power on.
79. Wait for the boot code to launch the main application.
80. Load the modified TAWS 10.6 software with the debugger (SCN 10.6fb).
81. Start the application with the debugger.
82. Make sure the version field shows 10.6fb.

83. Turn off capture mode.
84. Continue with steps 59 through 65.

APPENDIX C EXTRACTED ALERT LOG
April 10, 2010, Alert Log Extracted from NVRAM

Alert Record 38

Record CRC: 0x849da809 (Computed: 0x849da809)
Record Size: 394
Alert Record Type: LANDING
Alert Date (M/D/Y): 04/10/2010
Alert Time (H:M:S): 06:40:59
SCN Version: 10
SCN Revision: 6
Alert: RWS_WARNING
Alerts: 0x00000000
Inhibits: 0x00000000
Tail Number: 101
From Leg: ???
To Waypoint: XUBS
Origin Airport: none
Origin Runway: none
Destination Airport: none
Destination Runway: none
Flight Phase: APPROACH
Flight Plan Adherence: 0
Present Position Latitude: 54.825022 deg
Present Position Longitude: 32.054838 deg
Airplane Altitude: 670.291288 ft
Baro Altitude: 671.000000 ft
Radio Altitude: 41.562500 ft
Sink Rate: 394.352188 ft/min
Selected Altitude: 0.000000 ft
Closure Rate: 705.096987 ft/min
Groundspeed: 145.125000 kts
True Airspeed: 137.312500 kts
Indicated Airspeed: 139.437500 kts
Flaps in Landing: 1
Gear Down: 1
On Ground: 1
Glideslope Inhibit: 0
Decision Height Inhibit: 0
Flap Inhibit: 0
Terrain Inhibit: 0
Master Audio Cancel: 0
Inhibit All Modes: 0
Takeoff/Go-around: 0
Backcourse Approach: 0
Required Nav Precision: 1.000000 nm
Estimated Pos Uncertainty: 0.100000 nm
Terr Required Pos Accuracy: 0.500000 nm
Manuever Distance: 0.017777 ft
Pilot Reaction Distance: 1.054002 ft
Curr Required Obs Clearance: 100.000003 ft
Glideslope Deviation: 0.095982 dots
Localizer Deviation: 0.108367 dots
Localizer Tuned: 0
ILS Mode: 0
True Track: -92.988281 deg
Track Rate: -0.064736 deg/sec
Cross Track: 0.343750 nm
Terr Conflict Latitude: 54.825221 deg
Terr Conflict Longitude: 32.061042 deg
Terr Conflict Elevation: 813.648320 ft
Roll Angle: 0.000000 deg
Nav Frequency: 0.000008
QFE Selected: 0
QFE Ref Airport:
QFE Mode Status: QFE_NOT_ACTIVE
MSL Altitude: 1002.226390 feet

Alert Record 37

Record CRC: 0x2ce09751 (Computed: 0x2ce09751)
Record Size: 394
Alert Record Type: ALERT
Alert Date (M/D/Y): 04/10/2010
Alert Time (H:M:S): 06:40:43
SCN Version: 10
SCN Revision: 6
Alert: TERRAIN_IMPACT_WARNING
Alerts: 0x00200040
Inhibits: 0xfe7fffff
Tail Number: 101
From Leg: ???
To Waypoint: XUBS
Origin Airport: EPWA
Origin Runway: W11
Destination Airport: none
Destination Runway: none
Flight Phase: APPROACH
Flight Plan Adherence: 0
Present Position Latitude: 54.825543 deg
Present Position Longitude: 32.073911 deg
Airplane Altitude: 751.679206 ft
Baro Altitude: 752.000000 ft
Radio Altitude: 323.250000 ft
Sink Rate: -1505.013753 ft/min
Selected Altitude: 0.000000 ft
Closure Rate: 187.173677 ft/min
Groundspeed: 154.750000 kts
True Airspeed: 144.312500 kts
Indicated Airspeed: 146.500000 kts
Flaps in Landing: 1
Gear Down: 1
On Ground: 0
Glideslope Inhibit: 0
Decision Height Inhibit: 0
Flap Inhibit: 0
Terrain Inhibit: 0
Master Audio Cancel: 0
Inhibit All Modes: 0
Takeoff/Go-around: 0
Backcourse Approach: 0
Required Nav Precision: 1.000000 nm
Estimated Pos Uncertainty: 0.100000 nm
Terr Required Pos Accuracy: 0.500000 nm
Manuever Distance: 40.272882 ft
Pilot Reaction Distance: 50.167127 ft
Curr Required Obs Clearance: 100.000003 ft
Glideslope Deviation: 0.095982 dots
Localizer Deviation: 0.108367 dots
Localizer Tuned: 0
ILS Mode: 0
True Track: -93.032227 deg
Track Rate: -0.190988 deg/sec
Cross Track: 0.546875 nm
Terr Conflict Latitude: 54.825701 deg
Terr Conflict Longitude: 32.079091 deg
Terr Conflict Elevation: 754.593200 ft
Roll Angle: 0.000000 deg
Nav Frequency: 0.000008
QFE Selected: 0
QFE Ref Airport:
QFE Mode Status: QFE_NOT_ACTIVE
MSL Altitude: 1264.347891 feet

Alert Record 36

Record CRC: 0x6a49bf32 (Computed: 0x6a49bf32)
Record Size: 394
Alert Record Type: ALERT
Alert Date (M/D/Y): 04/10/2010
Alert Time (H:M:S): 06:40:36
SCN Version: 10
SCN Revision: 6
Alert: ROC_WARNING
Alerts: 0x00000020
Inhibits: 0xfe7fffff
Tail Number: 101
From Leg: ???
To Waypoint: XUBS
Origin Airport: EPWA
Origin Runway: W11
Destination Airport: none
Destination Runway: none
Flight Phase: APPROACH
Flight Plan Adherence: 0
Present Position Latitude: 54.825776 deg
Present Position Longitude: 32.082479 deg
Airplane Altitude: 933.464549 ft
Baro Altitude: 933.000000 ft
Radio Altitude: 425.562500 ft
Sink Rate: -1513.345078 ft/min
Selected Altitude: 0.000000 ft
Closure Rate: -1606.621685 ft/min
Groundspeed: 156.125000 kts
True Airspeed: 149.000000 kts
Indicated Airspeed: 150.750000 kts
Flaps in Landing: 1
Gear Down: 1
On Ground: 0
Glideslope Inhibit: 0
Decision Height Inhibit: 0
Flap Inhibit: 0
Terrain Inhibit: 0
Master Audio Cancel: 0
Inhibit All Modes: 0
Takeoff/Go-around: 0
Backcourse Approach: 0
Required Nav Precision: 1.000000 nm
Estimated Pos Uncertainty: 0.100000 nm
Terr Required Pos Accuracy: 0.500000 nm
Manuever Distance: 40.719994 ft
Pilot Reaction Distance: 50.444838 ft
Curr Required Obs Clearance: 100.000003 ft
Glideslope Deviation: 0.095982 dots
Localizer Deviation: 0.108367 dots
Localizer Tuned: 0
ILS Mode: 0
True Track: -91.757813 deg
Track Rate: 0.034652 deg/sec
Cross Track: 0.640625 nm
Terr Conflict Latitude: 54.825639 deg
Terr Conflict Longitude: 32.074702 deg
Terr Conflict Elevation: 754.593200 ft
Roll Angle: 0.000000 deg
Nav Frequency: 0.000008
QFE Selected: 0
QFE Ref Airport:
QFE Mode Status: QFE_NOT_ACTIVE
MSL Altitude: 1410.346283 feet

Alert Record 35

Record CRC: 0x1lea0cea5 (Computed: 0x1lea0cea5)
Record Size: 394
Alert Record Type: ALERT
Alert Date (M/D/Y): 04/10/2010
Alert Time (H:M:S): 06:40:29
SCN Version: 10
SCN Revision: 6
Alert: ROC_CAUTION
Alerts: 0x00002000
Inhibits: 0xfe7fffff
Tail Number: 101
From Leg: ???
To Waypoint: XUBS
Origin Airport: EPWA
Origin Runway: W11
Destination Airport: none
Destination Runway: none
Flight Phase: APPROACH
Flight Plan Adherence: 0
Present Position Latitude: 54.825939 deg
Present Position Longitude: 32.091148 deg
Airplane Altitude: 1104.448535 ft
Baro Altitude: 1104.000000 ft
Radio Altitude: 699.250000 ft
Sink Rate: -1335.726030 ft/min
Selected Altitude: 0.000000 ft
Closure Rate: -2335.895723 ft/min
Groundspeed: 157.625000 kts
True Airspeed: 148.500000 kts
Indicated Airspeed: 150.312500 kts
Flaps in Landing: 1
Gear Down: 1
On Ground: 0
Glideslope Inhibit: 0
Decision Height Inhibit: 0
Flap Inhibit: 0
Terrain Inhibit: 0
Master Audio Cancel: 0
Inhibit All Modes: 0
Takeoff/Go-around: 0
Backcourse Approach: 0
Required Nav Precision: 1.000000 nm
Estimated Pos Uncertainty: 0.100000 nm
Terr Required Pos Accuracy: 0.500000 nm
Manuever Distance: 31.722437 ft
Pilot Reaction Distance: 44.524202 ft
Curr Required Obs Clearance: 100.000003 ft
Glideslope Deviation: 0.095982 dots
Localizer Deviation: 0.108367 dots
Localizer Tuned: 0
ILS Mode: 0
True Track: -92.021484 deg
Track Rate: -0.035022 deg/sec
Cross Track: 0.738281 nm
Terr Conflict Latitude: 54.825430 deg
Terr Conflict Longitude: 32.066094 deg
Terr Conflict Elevation: 813.648320 ft
Roll Angle: 0.000000 deg
Nav Frequency: 0.000008
QFE Selected: 0
QFE Ref Airport:
QFE Mode Status: QFE_NOT_ACTIVE
MSL Altitude: 1595.344749 feet

Alert Record 34

Record CRC: 0xdeca5e93 (Computed: 0xdeca5e93)
Record Size: 394
Alert Record Type: ALERT
Alert Date (M/D/Y): 04/10/2010
Alert Time (H:M:S): 06:40:03
SCN Version: 10
SCN Revision: 6
Alert: ROC_CAUTION
Alerts: 0x00002000
Inhibits: 0xfe7fffff
Tail Number: 101
From Leg: ???
To Waypoint: XUBS
Origin Airport: EPWA
Origin Runway: W11
Destination Airport: none
Destination Runway: none
Flight Phase: APPROACH
Flight Plan Adherence: 0
Present Position Latitude: 54.826754 deg
Present Position Longitude: 32.125595 deg
Airplane Altitude: 1080.053887 ft
Baro Altitude: 1080.000000 ft
Radio Altitude: 1159.312500 ft
Sink Rate: -1440.873006 ft/min
Selected Altitude: 0.000000 ft
Closure Rate: -398.302534 ft/min
Groundspeed: 177.750000 kts
True Airspeed: 161.687500 kts
Indicated Airspeed: 160.812500 kts
Flaps in Landing: 1
Gear Down: 1
On Ground: 0
Glideslope Inhibit: 0
Decision Height Inhibit: 0
Flap Inhibit: 0
Terrain Inhibit: 0
Master Audio Cancel: 0
Inhibit All Modes: 0
Takeoff/Go-around: 0
Backcourse Approach: 0
Required Nav Precision: 1.000000 nm
Estimated Pos Uncertainty: 0.100000 nm
Terr Required Pos Accuracy: 0.500000 nm
Manuever Distance: 36.913326 ft
Pilot Reaction Distance: 48.029102 ft
Curr Required Obs Clearance: 100.000003 ft
Glideslope Deviation: 0.095982 dots
Localizer Deviation: 0.108367 dots
Localizer Tuned: 0
ILS Mode: 0
True Track: -94.042969 deg
Track Rate: 0.067435 deg/sec
Cross Track: 1.109375 nm
Terr Conflict Latitude: 54.825680 deg
Terr Conflict Longitude: 32.099149 deg
Terr Conflict Elevation: 754.593200 ft
Roll Angle: 0.000000 deg
Nav Frequency: 0.000008
QFE Selected: 0
QFE Ref Airport:
QFE Mode Status: QFE_NOT_ACTIVE
MSL Altitude: 2132.087732 feet

Alert Record 33

Record CRC: 0x921a8664 (Computed: 0x921a8664)
Record Size: 394
Alert Record Type: TAKEOFF
Alert Date (M/D/Y): 04/10/2010
Alert Time (H:M:S): 05:27:11
SCN Version: 10
SCN Revision: 6
Alert: RWS_WARNING
Alerts: 0x00000000
Inhibits: 0x00000000
Tail Number: 101
From Leg: ???
To Waypoint:
Origin Airport: EPWA
Origin Runway: none
Destination Airport: EPWA
Destination Runway: W29
Flight Phase: APPROACH
Flight Plan Adherence: 0
Present Position Latitude: 52.165796 deg
Present Position Longitude: 20.966862 deg
Airplane Altitude: 259.100424 ft
Baro Altitude: 259.000000 ft
Radio Altitude: 7.500000 ft
Sink Rate: -345.840604 ft/min
Selected Altitude: 0.000000 ft
Closure Rate: 206.347534 ft/min
Groundspeed: 144.000000 kts
True Airspeed: 141.500000 kts
Indicated Airspeed: 144.375000 kts
Flaps in Landing: 0
Gear Down: 1
On Ground: 0
Glideslope Inhibit: 0
Decision Height Inhibit: 0
Flap Inhibit: 0
Terrain Inhibit: 0
Master Audio Cancel: 0
Inhibit All Modes: 0
Takeoff/Go-around: 1
Backcourse Approach: 0
Required Nav Precision: 1.000000 nm
Estimated Pos Uncertainty: 0.100000 nm
Terr Required Pos Accuracy: 0.500000 nm
Manuever Distance: 0.000000 ft
Pilot Reaction Distance: 0.000000 ft
Curr Required Obs Clearance: 0.000000 ft
Glideslope Deviation: 2.330357 dots
Localizer Deviation: 2.386593 dots
Localizer Tuned: 0
ILS Mode: 1
True Track: -61.171875 deg
Track Rate: -0.062111 deg/sec
Cross Track: -0.011719 nm
Terr Conflict Latitude: 0.000000 deg
Terr Conflict Longitude: 0.000000 deg
Terr Conflict Elevation: 0.000000 ft
Roll Angle: 0.000000 deg
Nav Frequency: 0.000204
QFE Selected: 0
QFE Ref Airport:
QFE Mode Status: QFE_NOT_ACTIVE
MSL Altitude: 591.030886 feet

April 10, 2010, Alert Log Extracted from RS-232 Port

=====

Landing 04/10/10 06:40:59
Scn#:10.6 Alert Var:00000000 Inhibit Input Var:00000000
Tail#:101 Active ROC: 100 Ft Flt Phase:APPROACH
Org Airport:none Dest Airport:none From Leg:???
Org Runway:none Dest Runway:none To Leg:XUBS
Baro Alt: 671 Ft Ppos Lat: 54.83 Ppos Lon: 32.05
Plane Alt: 670 Ft Radio Alt: 41 Ft Sel Alt: 0 Ft
G/S Dev: 0.10 Dot Close Rate: 705 Fpm Sink Rate: 394 Fpm
Rnp: 1.00 Nm Epu: 0.10 Nm Trpa: 0.50 Nm
Gnd Speed:145 Kts Air Speed:137 Kts All Modes Inh:NO INHIBIT
Flaps:FLAPS Air/Ground:GROUND G/S Inh:NO INHIBIT
Gear:DOWN Flap Inh:NO INHIBIT Terrain Inh:NO INHIBIT
Master_Audio_Cancel:NO CANCEL Toga:NO TOGA
Backcourse Approach:INACTIVE FP_Adherence:FALSE
Mnvr Dist: 0.0 Ft Plt React Dist: 1.1 Ft
True Track Angle -93.0 Deg True Track Rate: -0.06 Deg
Cross Track Dist: 0.34 Nm ILS_1/2 Mode:FF
Terr Conflict Lat: 54.83 Terr Conflict Lon: 32.06
Terr Conflict Elev: 813 Roll Angle: 0.00 Deg
Nav Freq: 0.00 LOC DEV: 0.11 Dot LOC TUNED:FALSE
Qfe Selected:NOT SEL'D Qfe Airport: Qfe Mode:NOT ACTIVE
MSL Alt: 1002 Ft

=====

WARNING: Terrain (IMPACT) 04/10/10 06:40:43
Scn#:10.6 Alert Var:00200040 Inhibit Input Var:FE7FFFFF
Tail#:101 Active ROC: 100 Ft Flt Phase:APPROACH
Org Airport:EPWA Dest Airport:none From Leg:???
Org Runway:W11 Dest Runway:none To Leg:XUBS
Baro Alt: 752 Ft Ppos Lat: 54.83 Ppos Lon: 32.07
Plane Alt: 751 Ft Radio Alt: 323 Ft Sel Alt: 0 Ft
G/S Dev: 0.10 Dot Close Rate: 187 Fpm Sink Rate: -1505 Fpm
Rnp: 1.00 Nm Epu: 0.10 Nm Trpa: 0.50 Nm
Gnd Speed:154 Kts Air Speed:144 Kts All Modes Inh:NO INHIBIT
Flaps:FLAPS Air/Ground:AIR G/S Inh:NO INHIBIT
Gear:DOWN Flap Inh:NO INHIBIT Terrain Inh:NO INHIBIT
Master_Audio_Cancel:NO CANCEL Toga:NO TOGA
Backcourse Approach:INACTIVE FP_Adherence:FALSE
Mnvr Dist: 40.3 Ft Plt React Dist: 50.2 Ft
True Track Angle -93.0 Deg True Track Rate: -0.19 Deg
Cross Track Dist: 0.55 Nm ILS_1/2 Mode:FF
Terr Conflict Lat: 54.83 Terr Conflict Lon: 32.08
Terr Conflict Elev: 754 Roll Angle: 0.00 Deg
Nav Freq: 0.00 LOC DEV: 0.11 Dot LOC TUNED:FALSE
Qfe Selected:NOT SEL'D Qfe Airport: Qfe Mode:NOT ACTIVE
MSL Alt: 1264 Ft

```
=====
WARNING: Terrain (ROC)                                04/10/10 06:40:36
Scn#:10.6      Alert Var:00000020      Inhibit Input Var:FE7FFFFF
Tail#:101      Active ROC: 100 Ft      Flt Phase:APPROACH
Org Airport:EPWA      Dest Airport:none      From Leg:???
Org Runway:W11      Dest Runway:none      To Leg:XUBS
Baro Alt: 933 Ft      Ppos Lat: 54.83      Ppos Lon: 32.08
Plane Alt: 933 Ft      Radio Alt: 425 Ft      Sel Alt: 0 Ft
G/S Dev: 0.10 Dot      Close Rate: -1606 Fpm      Sink Rate: -1513 Fpm
Rnp: 1.00 Nm      Epu: 0.10 Nm      Trpa: 0.50 Nm
Gnd Speed:156 Kts      Air Speed:149 Kts      All Modes Inh:NO INHIBIT
Flaps:FLAPS      Air/Ground:AIR      G/S Inh:NO INHIBIT
Gear:DOWN      Flap Inh:NO INHIBIT      Terrain Inh:NO INHIBIT
Master_Audio_Cancel:NO CANCEL      Toga:NO TOGA
Backcourse Approach:INACTIVE      FP_Adherence:FALSE
Mnvr Dist: 40.7 Ft      Plt React Dist: 50.4 Ft
True Track Angle -91.8 Deg      True Track Rate: 0.03 Deg
Cross Track Dist: 0.64 Nm      ILS_1/2 Mode:FF
Terr Conflict Lat: 54.83      Terr Conflict Lon: 32.07
Terr Conflict Elev: 754      Roll Angle: 0.00 Deg
Nav Freq: 0.00      LOC DEV: 0.11 Dot      LOC TUNED:FALSE
Qfe Selected:NOT SEL'D      Qfe Airport:      Qfe Mode:NOT ACTIVE
MSL Alt: 1410 Ft
=====
```

```
CAUTION: Terrain (ROC)                                04/10/10 06:40:29
Scn#:10.6      Alert Var:00002000      Inhibit Input Var:FE7FFFFF
Tail#:101      Active ROC: 100 Ft      Flt Phase:APPROACH
Org Airport:EPWA      Dest Airport:none      From Leg:???
Org Runway:W11      Dest Runway:none      To Leg:XUBS
Baro Alt: 1104 Ft      Ppos Lat: 54.83      Ppos Lon: 32.09
Plane Alt: 1104 Ft      Radio Alt: 699 Ft      Sel Alt: 0 Ft
G/S Dev: 0.10 Dot      Close Rate: -2335 Fpm      Sink Rate: -1335 Fpm
Rnp: 1.00 Nm      Epu: 0.10 Nm      Trpa: 0.50 Nm
Gnd Speed:157 Kts      Air Speed:148 Kts      All Modes Inh:NO INHIBIT
Flaps:FLAPS      Air/Ground:AIR      G/S Inh:NO INHIBIT
Gear:DOWN      Flap Inh:NO INHIBIT      Terrain Inh:NO INHIBIT
Master_Audio_Cancel:NO CANCEL      Toga:NO TOGA
Backcourse Approach:INACTIVE      FP_Adherence:FALSE
Mnvr Dist: 31.7 Ft      Plt React Dist: 44.5 Ft
True Track Angle -92.0 Deg      True Track Rate: -0.04 Deg
Cross Track Dist: 0.74 Nm      ILS_1/2 Mode:FF
Terr Conflict Lat: 54.83      Terr Conflict Lon: 32.07
Terr Conflict Elev: 813      Roll Angle: 0.00 Deg
Nav Freq: 0.00      LOC DEV: 0.11 Dot      LOC TUNED:FALSE
Qfe Selected:NOT SEL'D      Qfe Airport:      Qfe Mode:NOT ACTIVE
MSL Alt: 1595 Ft
```

```
=====
CAUTION: Terrain (ROC)                                04/10/10 06:40:03
Scn#:10.6      Alert Var:00002000      Inhibit Input Var:FE7FFFFF
Tail#:101      Active ROC: 100 Ft      Flt Phase:APPROACH
Org Airport:EPWA      Dest Airport:none      From Leg:???
Org Runway:W11      Dest Runway:none      To Leg:XUBS
Baro Alt: 1080 Ft      Ppos Lat: 54.83      Ppos Lon: 32.13
Plane Alt: 1080 Ft      Radio Alt: 1159 Ft      Sel Alt: 0 Ft
G/S Dev: 0.10 Dot      Close Rate: -398 Fpm      Sink Rate: -1440 Fpm
Rnp: 1.00 Nm      Epu: 0.10 Nm      Trpa: 0.50 Nm
Gnd Speed:177 Kts      Air Speed:161 Kts      All Modes Inh:NO INHIBIT
Flaps:FLAPS      Air/Ground:AIR      G/S Inh:NO INHIBIT
Gear:DOWN      Flap Inh:NO INHIBIT      Terrain Inh:NO INHIBIT
Master_Audio_Cancel:NO CANCEL      Toga:NO TOGA
Backcourse Approach:INACTIVE      FP_Adherence:FALSE
Mnvr Dist: 36.9 Ft      Plt React Dist: 48.0 Ft
True Track Angle -94.0 Deg      True Track Rate: 0.07 Deg
Cross Track Dist: 1.11 Nm      ILS_1/2 Mode:FF
Terr Conflict Lat: 54.83      Terr Conflict Lon: 32.10
Terr Conflict Elev: 754      Roll Angle: 0.00 Deg
Nav Freq: 0.00      LOC DEV: 0.11 Dot      LOC TUNED:FALSE
Qfe Selected:NOT SEL'D      Qfe Airport:      Qfe Mode:NOT ACTIVE
MSL Alt: 2132 Ft
=====
```

```
=====
Takeoff                                04/10/10 05:27:11
Scn#:10.6      Alert Var:00000000      Inhibit Input Var:00000000
Tail#:101      Active ROC: 0 Ft      Flt Phase:APPROACH
Org Airport:EPWA      Dest Airport:EPWA      From Leg:???
Org Runway:none      Dest Runway:W29      To Leg:
Baro Alt: 259 Ft      Ppos Lat: 52.17      Ppos Lon: 20.97
Plane Alt: 259 Ft      Radio Alt: 7 Ft      Sel Alt: 0 Ft
G/S Dev: 2.33 Dot      Close Rate: 206 Fpm      Sink Rate: -345 Fpm
Rnp: 1.00 Nm      Epu: 0.10 Nm      Trpa: 0.50 Nm
Gnd Speed:144 Kts      Air Speed:141 Kts      All Modes Inh:NO INHIBIT
Flaps:NO FLAPS      Air/Ground:AIR      G/S Inh:NO INHIBIT
Gear:DOWN      Flap Inh:NO INHIBIT      Terrain Inh:NO INHIBIT
Master_Audio_Cancel:NO CANCEL      Toga:TOGA
Backcourse Approach:INACTIVE      FP_Adherence:FALSE
Mnvr Dist: 0.0 Ft      Plt React Dist: 0.0 Ft
True Track Angle -61.2 Deg      True Track Rate: -0.06 Deg
Cross Track Dist: -0.01 Nm      ILS_1/2 Mode:TF
Terr Conflict Lat: 0.00      Terr Conflict Lon: 0.00
Terr Conflict Elev: 0      Roll Angle: 0.00 Deg
Nav Freq: 0.00      LOC DEV: 2.39 Dot      LOC TUNED:FALSE
Qfe Selected:NOT SEL'D      Qfe Airport:      Qfe Mode:NOT ACTIVE
MSL Alt: 591 Ft
=====
```


APPENDIX D EXTRACTED FAULT LOG

April 10, 2010, Fault Log Extracted from RS-232 Port

=====

Fault ILS 1 DIGITAL FAIL
Date/Time (Initial) 04/10/10 06:41:02
Date/Time (Last) 04/10/10 06:41:02
Occurrences 1
SCN# 10.6
Additional Data 1 11 0x0000000B
Additional Data 2 1 0x00000001

Tail ID 101

=====

Fault GEAR RC FAIL
Date/Time (Initial) 04/10/10 06:41:02
Date/Time (Last) 04/10/10 06:41:02
Occurrences 1
SCN# 10.6
Additional Data 1 0 0x00000000
Additional Data 2 0 0x00000000

Tail ID 101

=====

Fault FLAPS RC FAIL
Date/Time (Initial) 04/10/10 06:40:59
Date/Time (Last) 04/10/10 06:40:59
Occurrences 1
SCN# 10.6
Additional Data 1 0 0x00000000
Additional Data 2 0 0x00000000

Tail ID 101

=====

APPENDIX E EXTRACTED CONFIGURATION LOG

```
TAWs Configuration
Analog Inputs
ADC
  True Airspeed..... NO_DEVICE
  Baro Altitude..... NO_DEVICE
  Altitude Rate..... NO_DEVICE
ILS
  ILS1
    LOC Device..... NO_DEVICE
    G/S Device..... NO_DEVICE
  ILS2
    LOC Device..... NO_DEVICE
    G/S Device..... NO_DEVICE
RA
  RA 1.....PB-5M
  RA 2.....PB-5M
ATT
  Roll..... NO_DEVICE
Digital I/O
A429 Inputs
  Port1.....PRIMARY FMS HS
  Port2.....SECONDARY FMS HS
  Port3.....no device
  Port4.....ADC LS
  Port5.....ILS ONE LS
  Port6.....no device
  Port7.....no device
  Port8.....UMFD HS
  Port9.....no device
  Port10.....no device
  Port11.....no device
  Port12.....no device
A429 Outputs
  Port1.....FMS HS
  Port2.....no device
  Port3.....no device
  Port4.....IMAGE CNTL HS
CSDB Inputs
  Port1..... NO_DEVICE
  Port2..... NO_DEVICE
SCI Inputs
  Port1..... NO_DEVICE
  Port2..... NO_DEVICE
WXR Outputs
Control
  Device.....no device
Output
  Predefined
    Device.....no device
  User Defined
    Base Device.....A708-6
    Mode Box
      Enable.....Default
      X Position.....+0
      Y Position.....+0
    Altitude Box
      Enable.....Default
      X Position.....+0
      Y Position.....+0
    Colors.....D
    Sweep Range.....DEF
    Intersect Angle.....0
    Radial Interval.....Default
Interleave
  Interleave.....Interleave_No
Orientation
  Type.....TRACK UP
```

```
Data Rates
  Baro Alt.....16
  Track..... 1
  Radio Alt.....20
Ethernet
  Ethernet 10T.....DTU
GPS Altitude
  Datum.....WGS84
Discrete I/O
  Inputs
    G/S Inhibit.....Assert Ground
    Flap Inhibit.....Assert Ground
    Gear Inhibit.....Not Installed
    Terrain Inhibit.....Alerts/Disp
    All Modes Inhibit.....Assert Ground
    Master Audio Cancel.....Not Installed
    Self Test.....Assert Ground
    ILS Mode 1.....Assert Ground
    ILS Mode 2.....Assert Ground
    Back Course 1.....Not Installed
    Back Course 2.....Not Installed
    Gear Position Downlocked.....Assert Ground
    Flaps in Landing.....Assert Ground
    On Ground.....Assert Ground
    Captains Terrain Select.....Not Installed
    1st Officers Terrain Select.....Not Installed
    Minimums.....Not Installed
    QFE.....Assert Ground
    RWS Warning Input.....Assert Ground
    CDU Video Switch 1.....Not Installed
    CDU Video Switch 2.....Not Installed
    TOGA.....Not Installed
  Outputs
    TAWS Warning Light.....Assert Ground
    TAWS Caution Light.....Assert Ground
    GPWS Fail Light.....Assert Ground
    Terrain Fail Light.....Assert Ground
    TCAS Audio Inhibit.....Assert Ground
    G/S Manual Inhibit.....Assert Ground
    Flap Manual Inhibit.....Assert Ground
    G/S Caution Light.....Assert Ground
    Captions Terrain Relay Driver.....Not Installed
    1st Officers Terrain Relay Driver.....Not Installed
    QFE light.....Assert Ground
    Terrain Inhibit Light.....Assert Ground
Audio & Voice
  Alert Callouts
    2000ft.....Disabled
    1500ft.....Disabled
    1000ft.....Disabled
    900ft.....Disabled
    800ft.....Disabled
    700ft.....Disabled
    600ft.....Disabled
    500ft.....Enabled
    400ft.....Disabled
    300ft.....Disabled
    200ft.....Disabled
    100ft.....Disabled
    90ft.....Disabled
    80ft.....Disabled
    70ft.....Disabled
    60ft.....Disabled
    50ft.....Disabled
    40ft.....Disabled
    30ft.....Disabled
    20ft.....Disabled
    10ft.....Disabled
  Voice Parameters
    Radio Alt
      Value.....2450
```

```
Status.....Disabled
Minimums
  Value..... 500
  Status.....Disabled
Approaching Minimums
  Value..... 600
  Status.....Disabled
Bank Angle Limit
  Value..... 35
  Status.....Disabled
Callout Syntax
  Callout Syntax.....EURO
Aural Repeat
  Status.....EnabledDisabled1
Decision Height Inhibit
  Status.....NONE
Altimeter Setting
  Status.....Enabled
Alert Envelopes
  Mode 1.....1
  Mode 4.....1
Audio
  Speaker
    Low Output.....1.0
    High Output.....2.0
    Delta Power.....3.0
  Headset
    Low Output..... 40
    High Output..... 65
    Delta Power.....3.0
Video Display
  Output
    Type.....VGA
    Destination.....UMFD
  Pop-up
    Type.....VGA
    Destination.....UMFD
Graphics
  3-D Perspective Aircraft Symbol.....Type 1
FMS Pages
  Page Type.....A739-MAINT
Aircraft
  Type.....TURBO FAN
  Best Climb Rate @10,000 ft.....200
  Tail Number.....101
  RA Maximum Altitude.....2500
Version
  ID..... 964557970
  Length..... 876
  Last Configuration Update.....5/23/2003
  For use with TAWS Software Version.....10_6_2
  Comment.....Installer comments
  CRC.....3158491925
```

¹ Aural Repeat value corrected during data validation.