Federal Aviation Administration

Memorandum

Date: July 29, 2015

From: Gilbert Ceballos
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To: Mr. Peter Wentz
Survival Factors Investigator AS-60, National Transportation Safety Board (NTSB)

Prepared by: Gilbert Ceballos

Subject: Teardown investigation of an Ameri-King AK-450-[] series Emergency Locator Transmitter (ELT) sent from the National Transportation Safety Board (NTSB). (Refer to NTSB ERA14FA464)

Summary

The National Transportation Safety Board (NTSB) requested the Los Angeles Aircraft Certification Office (LAACO) to support a teardown inspection and testing of an Ameri-King AK-450 series Emergency Locator Transmitter (ELT). On May 27, 2015 a team from the FAA Los Angeles Aircraft Certification Office (LA ACO) comprised of: Natalie Phan-Tran (Senior Engineer), Louise Wu (Acting Senior ASI), Gilbert Ceballos (ASE) and Eric Igama (ASE) traveled to Ameri-King in Huntington Beach to observe and report on the teardown investigation.

The LAACO brought the sealed ELT container received from the NTSB to the Ameri-King facility; it was opened onsite by Ameri-King personnel. Ameri-King AK-450 series ELT with serial number 436187 was recorded; however some of the participants thought the serial number could be 456187 due to the font style. General appearance of the unit was observed as good, intact.

The following tests were conducted on the Ameri-King AK-450 series ELT per Ameri-King manuals as instructed by the NTSB:

a. Transmitter Functional Test - IM-450 Rev A, para 3.3
b. Periodic Maintenance Test- IM-450 Rev A, para 3.4
c. Acceptance Test Report - ATP-450 Rev A
d. Measure voltage of each of the six batteries extracted from the main ELT unit.

All tests were completed and the results were observed as follows:

The Transmitter Functional Test swept tone signal was barely audible initially and then faded out, during the first run. On the subsequent run no tone was heard.

The Periodic Maintenance Test manifested the same weak swept tone sound response for the tests (Functional and G-Switch) included in the Periodic Maintenance Test.

The Acceptance Test Procedure (ATP) was also run; however it should be noted that Ameri-King did not use the test configuration or follow the steps documented in ATP-450 Rev A. The test

performed by Ameri-King was the Beacon Test; an automated test run via a Dell Axim X-50 Personal Digital Assistant (PDA). The tester was a WS Technologies Inc., model BT100AV Series ELT Tester.

It should be noted that the Transmitter Functional Test and Periodic Maintenance Test contained in the Ameri-King Installation Manual do not define explicit success criteria. The lack of explicit success criteria makes assessment of test quality (pass or fail) indeterminate. In addition, a revised or released alternate ATP never went through Ameri-King's drawing/document release system; nor was submitted for FAA approval. Assessment of the quality of the testing results was not performed, it was just observed and results reported.

The last test performed was measurement of the voltage of the "D" cell batteries that power the ELT main unit. The six Duracell "D" cell "copper top" batteries were removed intact from the ELT main unit. Note: "D" cell battery voltage is 1.5 V. The voltage of each battery was measured using a BK Precision Model 2703C Digital Multi-meter. The voltage for each battery was as follows:

Battery	**Voltage (V)**
1	1.574
2	1.565
3	1.569
4	1.565
5	1.574
6	1.568
AVG	1.569

Detailed Log of Events

Wednesday, May 27, 2015

The FAA team arrived at the Ameri-King facility in Huntington Beach at 1:29 PM PDT. I (Gilbert Ceballos) introduced the FAA team to the owner Mr. Keith Van. I explained to Mr. Van that we were there to complete a teardown investigation of an Ameri-King AK-450 series ELT in accordance with the NTSB request, record the process and take photographs. I also asked that Mr. Van have the personnel conducting the tests to go step-by-step and in a fashion that was at a pace sufficient for the FAA team to record the steps performed and the results. Mr. Van acknowledged he understood and would comply.

At 1:36 PM PDT the sealed ELT Main Unit was removed from the box by Mr. Michael Ta, Assembler at Ameri-King (Refer to Figure 1.). The ELT Main Unit was sealed in a tamper proof sealed bag (Refer to Figure 2.). The ELT Main Unit switch was in the OFF position. Upon removal from the tamper proof bag the part number and serial number were recorded. All participants agreed that the Main Unit part number was AK-450. The serial number appeared to be 436187; however some of the participants thought the serial number could be 456187 (Refer to Figure 3.).

When asked about checking production logs for the serial number; Mr. Van (of Ameri-King) explained the unit was either a year 2000 or 2001 production unit. Mr. Van stated he was only required to maintain production logs for 5 years.

At 1:49 PM PDT the position of the ELT Main Unit was observed to be in the off position (centered or neutral.).

At 1:51 PM PDT I asked Mr. Van who from Ameri-King would be performing the tests requested by the NTSB. Mr. Van informed me the tests would be performed by the following personnel: 1) Keith Van, Ameri-King QC Manager, 2) Roger Ha, Ameri-King Test Conductor and 3) Michael Ta, Ameri-King Assembler.

I asked Mr. Van what the test configuration (E.g. test equipment, interfacing equipment) entailed. The test setup included the following:

1. Unit under test: Ameri-King ELT Model Number: AK-450, Serial Number: 436187.
2. AM/FM Receiver: Uniden Bearcat Twin Turbo 100 Channel Air Band Radio Receiver, Serial Number: 45002580, Date of Manufacture OE1D.
3. Cockpit Remote Switch, Part Number: 450004, Serial Number: None
4. Cockpit Remote Cable.

Transmitter Functional Test (IM-450 Rev A, para 3.3)

At 2:19 PM PDT the Transmitter Functional Test - IM-450 Rev A, para 3.3 was executed. The steps were as follows:

Action Performed	Expected Result	Observed Result	Comments
1. ELT Main Unit armed. Switch on Main Unit switched to the ARM position. **NOTE**: The ELT Main Unit was armed prior to connecting to Cockpit Remote Switch.	ELT Main Unit switch is in the ARM position.	ELT Main Unit switch is in the ARM position.	Refer to Figure 4.

2. Cockpit Remote Switch connected to ELT Main Unit via cable interface.	Cockpit Remote Switch connected to ELT Main Unit via cable interface	Cockpit Remote Switch connected to ELT Main Unit via cable interface	Refer to Figure 5.
3. Switch on the ELT Main Unit switched to the ON position. **NOTE**: This step was not performed in accordance with the steps defined in the Installation Manual.	The green light on the Cockpit Remote Switch illuminates, the ELT Main Unit light illuminates and a swept tone is broadcast on the Receiver.	The green light on the Cockpit Remote Switch illuminated, the ELT Main Unit light illuminated and a weak swept tone was heard on the AM/FM Receiver.	Swept tone heard on the AM/FM Receiver was barely audible and then faded. Refer to Figure 6 and Figure 7. **NOTE**: The test conductor should have used the Cockpit Remote Switch to initiate this test step in accordance with the Installation Manual.
4. The conditions were reset by pressing the reset button on the Cockpit Remote Switch.	The green light on the Cockpit Remote Switch and the light on the ELT Main Unit are extinguished.	The green light on the Cockpit Remote Switch and the light on the ELT Main Unit were extinguished.	
5. The ON button on the Cockpit Remote Switch depressed to ON.	The green light on the Cockpit Remote Switch illuminates, the ELT Main Unit light illuminates and a swept tone is broadcast on the Receiver.	The green light on the Cockpit Remote Switch illuminated the ELT Main Unit light illuminated and a **NO** swept tone heard on the AM/FM Receiver.	**NO** tone heard on the AM/FM Receiver.
6. The conditions were reset by pressing the reset button on the Cockpit Remote Switch.	The green light on the Cockpit Remote Switch and the light on the ELT Main Unit are extinguished.	The green light on the Cockpit Remote Switch and the light on the ELT Main Unit were extinguished.	

Periodic Maintenance Test (IM-450 Rev A, para 3.4)

At 2:54 PM PDT started the Periodic Maintenance Test- IM-450 Rev A, para 3.4. Steps 1-3 of the test could **not** be performed as these steps require checking the installation of the ELT on the aircraft.

Instead of continuing to run the Periodic Maintenance Test- IM-450 Rev A, para 3.4; Mr. Van had Roger Ha run the Beacon Test. Due to the weak sweep tone heard during the Transmitter Functional Test; Mr. Van directed Mr. Ha to perform the Beacon Test in order to measure the signal power. The signal power level measured via the Beacon Test was 21.3 dBm. Per Mr. Ha the minimum acceptable level is 17.0 dBM.

Beacon Test was an automated test run via a Dell Axim X-50 Personal Digital Assistant (PDA). The tester was a WS Technologies Inc., model BT100AV Series ELT Tester. It should be noted that Mr. Ha entered the Serial Number of the ELT Main Unit as 456187, not 436187 for this run.

We continued the Periodic Maintenance Test- IM-450 Rev A, para 3.4. Ran the Transmitter Functional Test - IM-450 Rev A, para 3.3 per the procedure. Performed the following:

Action Performed	**Expected Result**	**Observed Result**	**Comments**
1. Check the expiration date of the ELT Main Unit and the Remote Unit Batteries.	Expiration dates of the ELT Main Unit and the Remote Unit Batteries checked.	ELT Main Unit expiration dated listed as 5-16-2011. Remote Unit batteries replaced by 2011.	
2. ELT Main Unit armed. Switch on Main Unit switched to the ARM position. **NOTE**: The ELT Main Unit was armed prior to connecting to Cockpit Remote Switch.	ELT Main Unit switch is in the ARM position.	ELT Main Unit switch is in the ARM position.	Refer to Figure 4.
3. Cockpit Remote Switch connected to ELT Main Unit via cable interface.	Cockpit Remote Switch connected to ELT Main Unit via cable interface	Cockpit Remote Switch connected to ELT Main Unit via cable interface	Refer to Figure 5.
4. The ON button on the Cockpit Remote Switch depressed to ON.	The green light on the Cockpit Remote Switch illuminates, the ELT Main Unit light illuminates and a swept tone is broadcast on the Receiver.	The green light on the Cockpit Remote Switch illuminated, the ELT Main Unit light illuminated and a weak swept tone was heard on the AM/FM Receiver.	Swept tone heard on the AM/FM Receiver was very weak. Refer to Figure 6 and Figure 7.
5. The conditions were reset by pressing the reset button on the Cockpit Remote Switch.	The green light on the Cockpit Remote Switch and the light on the ELT Main Unit are extinguished.	The green light on the Cockpit Remote Switch and the light on the ELT Main Unit were extinguished.	
6. The ON button on the Cockpit Remote Switch depressed to ON.	The green light on the Cockpit Remote Switch illuminates, the ELT Main Unit light illuminates and a swept tone is broadcast on the Receiver.	The green light on the Cockpit Remote Switch illuminated the ELT Main Unit light illuminated and a **NO** swept tone heard on the AM/FM Receiver.	**NO** tone heard on the AM/FM Receiver was very weak.
7. The conditions were reset by pressing the reset button on the Cockpit Remote Switch.	The green light on the Cockpit Remote Switch and the light on the ELT Main Unit are extinguished.	The green light on the Cockpit Remote Switch and the light on the ELT Main Unit were extinguished.	

8. ELT Main Unit armed. Switch on Main Unit switched to the ARM position.	ELT Main Unit switch is in the ARM position.	ELT Main Unit switch is in the ARM position.	Refer to Figure 4.
9. Test conductor grasped ELT Main Unit in both hands and used a rapid forward and backward (throwing) motion. **NOTE**: This check is to verify the G-Switch is working.	The ELT Main Unit light illuminates and a swept tone is broadcast on the Receiver.	The ELT Main Unit light illuminated and a weak swept tone was heard on the AM/FM Receiver.	Swept tone heard on the AM/FM Receiver was very weak. Refer to Figure 6 and Figure 7.
10. The conditions were reset by pressing the reset button on the ELT Main Unit.	The light on the ELT Main Unit is extinguished.	The light on the ELT Main Unit is extinguished.	

Upon concluding the Periodic Maintenance Test- IM-450 Rev A, para 3.4; the ELT Main Unit Main Switch was set to OFF. The ELT Main Unit was then disassembled by Mr. Ta. All four screws on the ELT Main Unit were observed to have corrosion present.

The six Duracell "D" cell "copper top" batteries were removed intact. The following observations were made of the batteries:

a) Slight corrosion present on bottom (negative terminal) and top (positive terminal) of the batteries.
b) Batteries all had the same expiration date: Mar 2016.
c) Five out of six of the batteries were corroded on the bottom (negative terminal).
d) Four out of six of the batteries were corroded on the top (positive terminal).
e) No evidence of battery leakage.

The ELT Main Unit was then reassembled by Mr. Ta. Re-ran the Transmitter Functional Test - IM-450 Rev A, para 3.3 per the procedure. Performed the following:

Action Performed	**Expected Result**	**Observed Result**	**Comments**
1. ELT Main Unit armed. Switch on Main Unit switched to the ARM position. **NOTE**: The ELT Main Unit was armed prior to connecting to Cockpit Remote Switch.	ELT Main Unit switch is in the ARM position.	ELT Main Unit switch is in the ARM position.	Refer to Figure 4.
2. Cockpit Remote Switch connected to ELT Main Unit via	Cockpit Remote Switch connected to ELT Main Unit via	Cockpit Remote Switch connected to ELT Main Unit via	Refer to Figure 5.

cable interface.	cable interface	cable interface	
3. The ON button on the Cockpit Remote Switch depressed to ON.	The green light on the Cockpit Remote Switch illuminates, the ELT Main Unit light illuminates and a swept tone is broadcast on the Receiver.	The green light on the Cockpit Remote Switch illuminated, the ELT Main Unit light illuminated and a weak swept tone was heard on the AM/FM Receiver.	Swept tone heard on the AM/FM Receiver was initially loud and then faded. Refer to Figure 6 and Figure 7.
4. The conditions were reset by pressing the reset button on the Cockpit Remote Switch.	The green light on the Cockpit Remote Switch and the light on the ELT Main Unit are extinguished.	The green light on the Cockpit Remote Switch and the light on the ELT Main Unit were extinguished.	
5. ELT Main Unit armed. Switch on Main Unit switched to the ARM position.	ELT Main Unit switch is in the ARM position.	ELT Main Unit switch is in the ARM position.	Refer to Figure 2
6. Test conductor grasped ELT Main Unit in both hands and used a rapid forward and backward (throwing) motion. **NOTE**: This check is to verify the G-Switch is working.	The ELT Main Unit light illuminates and a swept tone is broadcast on the Receiver.	The ELT Main Unit light illuminated and a weak swept tone was heard on the AM/FM Receiver.	Swept tone heard on the AM/FM Receiver was very weak and intermittent.
7. The conditions were reset by pressing the reset button on the ELT Main Unit.	The light on the ELT Main Unit is extinguished.	The light on the ELT Main Unit is extinguished.	
8. ELT Main Unit was disconnected from the Cockpit Remote Switch. Test conductor grasped ELT Main Unit in both hands and used a rapid forward and backward (throwing) motion. **NOTE**: This check is to verify the G-Switch is working.	The ELT Main Unit light illuminates and a swept tone is broadcast on the Receiver.	The ELT Main Unit light illuminated and a weak swept tone was heard on the AM/FM Receiver.	Swept tone heard on the AM/FM Receiver was very weak and intermittent.
9. The conditions were reset by	The light on the ELT Main Unit is	The light on the ELT Main Unit is	

pressing the reset button on the ELT Main Unit.	extinguished.	extinguished.	

Acceptance Test Procedure (ATP-450 Rev A)

At 3:52 PM PDT started the Ameri-King Acceptance Test Procedure - ATP-450 Rev A. Steps 1-10 of the test could **not** be executed. Per Mr. Van, the ATP procedure is obsolete. Per Mr. Van, the test configuration defined in the ATP is obsolete and is no longer used by Ameri-King.

It should be noted that Ameri-King replaced the FAA approved ATP with a different test method (an automated Beacon Test) without notifying the FAA by submitting a drawing change.

Mr. Van had Roger Ha run the Beacon Test using an automated test run via a Dell Axim X-50 Personal Digital Assistant (PDA). The tester was a WS Technologies Inc., model BT100AV Series ELT Tester. (Refer to Figure 8 and Figure 9.). It should be noted that Mr. Ha entered the Serial Number of the ELT Main Unit as 436187 for these two runs. The ATP was completed at 4:11 PM PDT.

The voltage of each battery was measured using a BK Precision Model 2703C Digital Multi-meter and is included in the table below (Refer to Figure 10 and Figure 11):

Battery	**Voltage (V)**
1	1.574
2	1.565
3	1.569
4	1.565
5	1.574
6	1.568
AVG	1.569

Photos from Test

Figure 1 Opening of NTSB shipping container

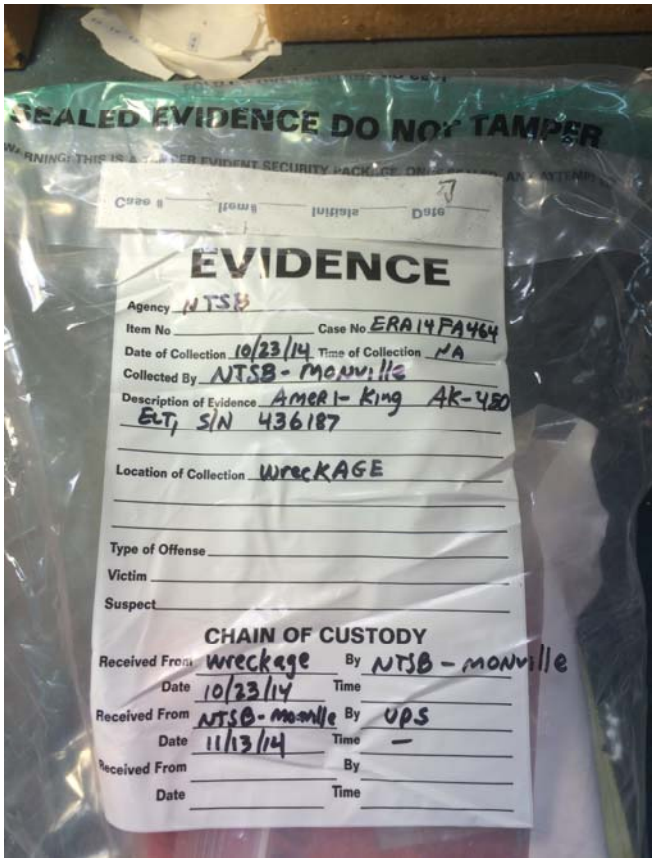

Figure 2 ELT in Sealed Container

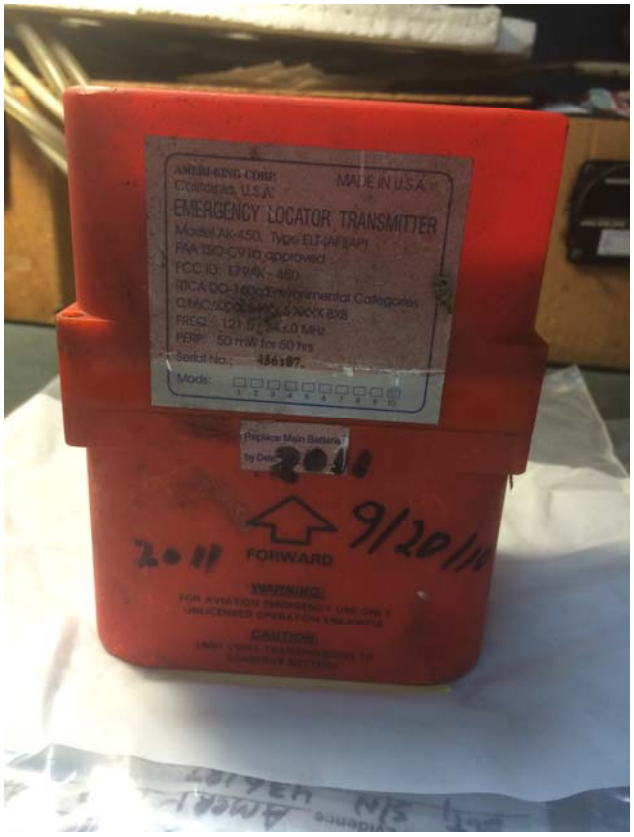

Figure 3 AK-450 Series ELT

Figure 4 ELT Main Unit - Switch in ARM position

Figure 5 Cockpit Remote Switch

Figure 6 Lights Illuminated on Cockpit Remote Switch and Main Unit

Figure 7 AM/FM Receiver

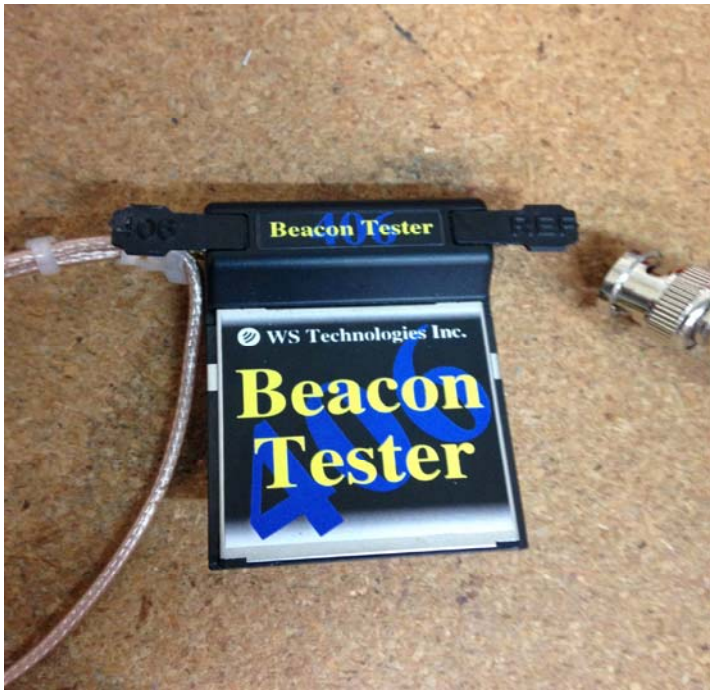

Figure 8 WS Technologies Beacon Tester

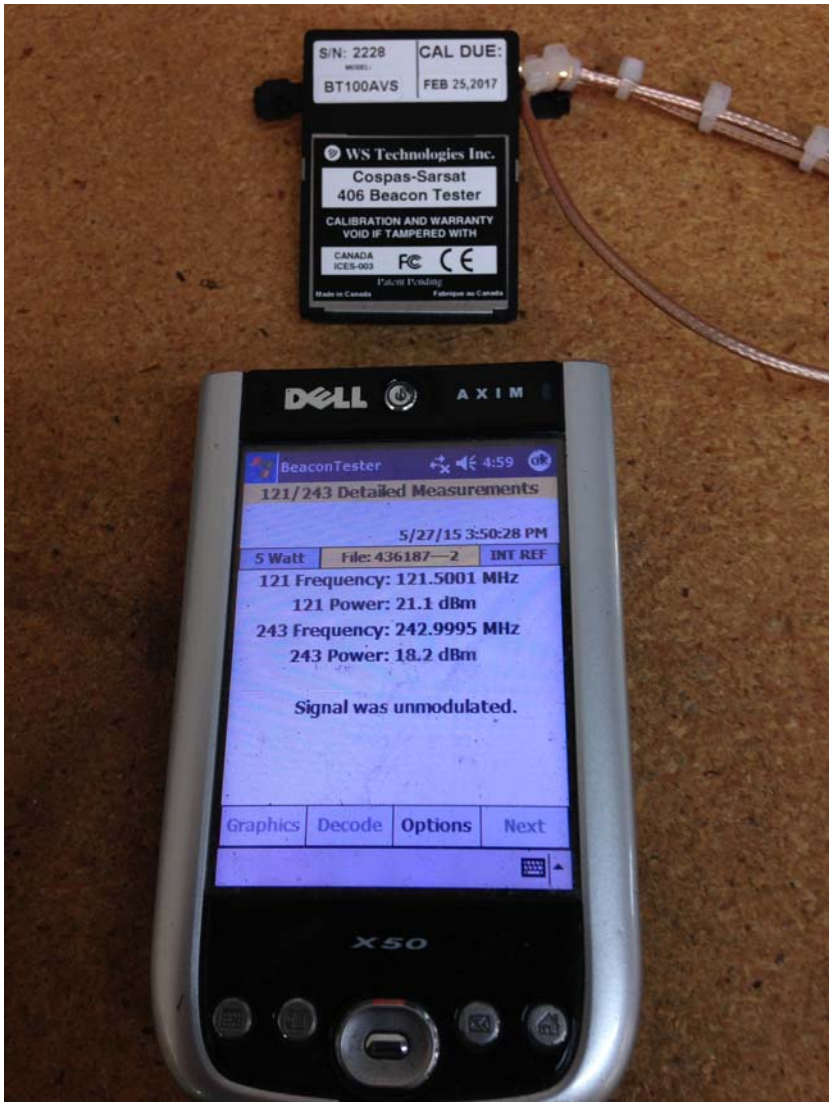

Figure 9 Reverse Side of Beacon Tester and PDA

Figure 10 Multi-meter and Batteries

Figure 11 ELT Main Unit Batteries