Report On

Emergency Beacons Testing of the
ACR Electronics Inc PLB-410
In accordance with Cospas-Sarsat T.007

Document 75946137 Report 02 Issue 4 **January 2021**

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REPORT ON

Emergency Beacons Testing of the
ACR Electronics Inc
PLB-410

Document 75946137 Report 02 Issue 4

January 2021

PREPARED FOR

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DATED

12 January 2021

UKAS TESTING 0141

CONTENTS

SECTION 1

REPORT SUMMARY

Emergency Beacons Testing of the
ACR Electronics Inc
PLB-410

1.1 INTRODUCTION

The information contained in this report is intended to show verification of the Emergency Beacon Testing of the ACR Electronics Inc PLB-410 to the requirements of Cospas-Sarsat T.007.

Objective	To perform Emergency Beacon Testing to determine the Equipment Under Test's (EUT's) compliance with the Test Specification, for the series of tests carried out.
Manufacturer	ACR Electronics Inc
Model Number(s)	PLB-410
Serial Number(s)	1 C/S (Conducted) 2 C/S (Radiated) PLB435 S/N: 9 C/S (75946138 TSR0005) - (RLM reception verification tests only)
Number of Samples Tested	3
Test Specification/Issue/Date	Cospas-Sarsat T.007 Issue 5 - Rev 3 February 2019
Date of Receipt of Test Samples	03 June 2019
Order Number Date	50201-00 23 May 2019
Start of Test	06 June 2019
Finish of Test	26 November 2019
Name of Engineer(s)	N Grigsby A Uminski
Related Documents	Cospas-Sarsat T.001 Issue 4 Rev 4 Feb 2019 Cospas-Sarsat T.IP (TCXO) Issue 1 Rev 5 Oct 2013

1.2 APPLICATION FORM

G.1 - Beacon Manufacturer and Beacon Model	
Beacon Manufacturer	ACR Electronics, Inc.
Beacon Manufacturer's Address	5757 Ravenswood Road
Beacon Model Name	PLB-410 and PLB-435
Additional Beacon Model Names	For PLB-410: ResQLink 410 RLS For PLB-435: ResQLink View RLS

G.1 - Beacon Type and Operational Configurations		
Beacon Type	Beacon Used While	Tick Where Appropriate (X)
EPIRB Float Free	Floating in water or on deck or in a safety raft	
EPIRB Non-Float Free (automatic and manual activation)	Floating in water or on deck or in a safety raft	
EPIRB Non-Float Free (manual activation only)	Floating in water or on deck or in a safety raft	
EPIRB Float Free with VDR	Floating in water or on deck or in a safety raft	
PLB	On ground and above ground	X
	On ground and above ground and floating in water	
	On ground, above ground, and on a personal floatation device*	X
ELT Survival	On ground and above ground	
	On ground and above ground and floating in water	
ELT Auto Fixed	Fixed ELT with aircraft external antenna	
ELT(DT)	Distress Tracking ELT with aircraft external antenna	
ELT Auto Portable	In aircraft with an external antenna	
	On ground, above ground, or in a safety raft with an integrated antenna	
ELT Auto Deployable	Deployable ELT with attached antenna	
Other (specify)		

* Applicable only to PLBs with integral antennas operated while attached to personal flotation devices (e.g. lifejackets) where the PLB and its antenna are mounted on PFD in such a position, that, in the nominal mode of operation, they are kept above water.

G.1 - Beacon Characteristics			
Characteristic	Declared Value		
Operating frequency (406 MHz operating channel = 406.nnn)	406.031 MHz		
Operating temperature range	Tmin = -20°C		Tmax= 55 °C
Temperature, at which minimum duration of continuous operation is expected (Submit C/S T.007 Section 5, part s, if applicable)	Tmin ☒		or Other (nn °C)
Manufacturer-declared Minimum Operating Lifetime* * this value is specified by National Administrations or International Organisations	YES for 406.031 MHz and 121.5 MHz N/A N/A N/A N/A		24 hours 48 hours 168 hours 50 hour Other hours, (specify)
Beacon power supply type (internal non-rechargeable, internal re-chargeable, external, combined, other)	Internal non -rechargeable		
External power supply parameters (AC/DC, nominal voltage, nominal minimum and nominal maximum voltage)		Current (AC / DC):	N/A
		Nominal Voltage (V):	N/A
		Nominal Minimum Voltage (V):	N/A
		Nominal Maximum Voltage (V):	N/A
Is external power supply needed to energise the beacon or its ancillary devices in any of operational modes (N/A or Yes or No)	N/A		
Battery cell chemistry	LiMnO2		
Battery cell model name, cell size, number of cells in a battery pack, and details of the battery pack electrical configuration		Cell Model Name:	CR-123A
		Cell Size:	2/3 A
		Number of Cells in Battery Pack:	3
		Details of the battery pack electrical configuration:	Series
Battery cell manufacturer	Panasonic		
Battery pack manufacturer and part number		Battery Pack Manufacturer Name:	ACR Electronics
		Battery Pack Part Number:	A3-06-2703
Beacon manufacturers declared maximum allowed cell shelf-life (from date of cell manufacture to date of battery pack installation in the beacon)	1		years
Declared beacon battery replacement period (from date of installation in the beacon to expiry date marked on the beacon)	5		years
Oscillator type (e.g. OCXO, MCXO, TCXO)	TCXO		
Oscillator manufacturer	RAKON (Made in New Zealand)		
Oscillator model name/ part number		Model Name:	
		Part Number:	RAKON P/N E6907LF, ACR P/N A1-11-1169
Oscillator satisfies long-term frequency stability requirements (Yes or No)	Yes		

Antenna type: Integral or Other (e.g. External, Detachable – specify type)	Integral		
Antenna manufacturer	ACR Electronics, Inc.		
Antenna part name and part number (OEM, if applicable, and beacon manufacturer's)	OEM Model Name:	PLB-400 and PLB-425 Antenna	
	OEM Part Number:	A3-06-3136	
	Beacon Manufacturer's Model Name:	PLB-400 and PLB-425 Antenna	
	Beacon Manufacturer's Part Number:	A3-06-3136	
Antenna cable assembly min/max RF- losses at 406 MHz, if applicable	Minimum loss (dB):	N/A	
	Maximum loss (dB):	N/A	
Navigation device type (Internal, External or None)	Internal		
Features in beacon that prevent degradation to 406 MHz signal or other beacon performances resulting from a failure of navigation device or failure to acquire position data (Yes, No, or N/A)	Yes		
Features in beacon that ensure erroneous position data is not encoded into the beacon message (Yes, No or N/A)	Yes		
Navigation device capable of supporting global coverage (Yes, No or N/A)	Yes		
Encoded position update capability (Yes, No, N/A) and	Yes		
Encoded position update interval value (range)	5 TO 60	minutes	
For Internal Navigation Devices	N/A		
Geodetic reference system (WGS 84 or GTRF)	WGS 84		
GNSS receiver cold start forced at every beacon activation (Yes or No)	Yes		
Navigation device manufacturer	uBlox		
Navigation device model name and part Number	Model Name:	SAM-M8Q GPS module	
	Part Number:	SAM-M8Q	
Internal navigation device antenna type(integrated, internal, external, passive/active) , manufacturer and model	Integral Ceramic to SAM-M8Q		
GNSS system supported (e.g. GPS, GLONASS, Galileo)	GPS for position, Galileo for RLM		
For External Navigation Devices	N/A		
Data protocol for GNSS receiver to beacon interface	N/A		
Physical interface for beacon to navigation device	N/A		
Electrical interface for beacon to navigation device	N/A		
Part number of the external navigation interface device (if applicable)	N/A		
Navigation device model and manufacturer (if beacon designed to use specific devices)	N/A		
Self-Test Mode Characteristics:	Self-Test Mode	Optional GNSS Self-test Mode	
Activated by a separate switch/ separate switch position (Yes or No)	Yes	Yes	
Self-test/GNSS self-test mode switch automatically returns to normal position when released (Yes or No)	Yes	Yes	
Self-test/ GNSS self-test activation can cause an operational mode transmission (Yes or No)	No	No	

Results in transmission of a single self-test burst only, regardless of how long the self-test activation mechanism is applied (Yes or No)	Yes	Yes
Results of self-test / GNSS self-test are indicated by (provide details, e.g. Pass / Fail indicator light, strobe light, etc.)	Yes, Red Green LEDs. Additionally displayed on PLB-435	Yes, Red Green LEDs. Additionally displayed on PLB-435
The content of the encoded position data fields of the self-test message has default values	Yes	N/A
Performs an internal check and indicates that RF-power is being emitted at 406 MHz and 121.5 MHz, if beacon includes a 121.5 Hz homer (Yes or No)	Yes	Yes
Self-test results in transmission of a signal other than at 406 MHz (Yes & details or No)	Yes, 121.5 MHz	No
Self-test can be activated directly at beacon (Yes or No)	Yes	Yes
List of Items checked by self-test	Battery, 406 Pwr/PLL lock, 121 Pwr, Non-volatile memory Battery Witness Battery Voltage GPS Com Check	Battery, GPS ACQ, 406 Burst
Self-test/ GNSS self-test 406 MHz burst duration (440 or 520 ms)	440	520
Self-test message length format flag in bit 25, ("0" or "1")	1	1
Maximum duration of a self-test mode, sec	14	110
Maximum recommended number of self-tests / GNSS self-tests during battery pack replacement period (as applicable)	60	20
Distinct indication of self-test start (Yes or No)	Yes	Yes
Indication of self-test results (Yes or No)	Yes	Yes
Distinct indication of insufficient battery capacity (Yes or No)	Yes	Yes
Automatic termination of self-test mode immediately after completion of the self-test cycle (Yes or No)	Yes	Yes
GNSS Self-test results in transmission of a single burst, irrespectively of the test result (Yes or No)	N/A	Yes
Self-test / GNSS self-test can be activated from beacon remote activation points (Yes & details or No)	No	No
List all methods of Self-test mode and GNSS Self-test modes activation. Provide details on a separate sheet to describe	Press Self-Test button 2 Sec to 5 Sec	Press Self-Test button for 5 Sec to 10 Sec

Message Coding Protocols	Protocol Option	Tick Where Appropriate (X)
User Protocol	Maritime with MMSI	
	Maritime with Radio Call Sign	
	EPIRB Float Free with Serial Number	
	EPIRB Non Float Free with Serial Number	
	Radio Call Sign	
	Aviation	
	ELT with Serial Number	
	ELT with Aircraft Operator and Serial Number	
	ELT with Aircraft 24-bit Address	
	PLB with Serial Number	
	National (Short Message Format)	
	National (Long Message Format)	
Standard Location Protocol	EPIRB with MMSI	
	EPIRB with Serial Number	
	ELT with 24-bit Address	
	ELT with Aircraft Operator Designator	
	ELT with Serial Number	
	PLB with Serial Number	
National Location Protocol	National Location: EPIRB	
	National Location: ELT	
	National Location: PLB	
ELT(DT) Location Protocol	ELT with Serial Number	
	ELT with Aircraft Operator and Serial Number	
	ELT with Aircraft 24-bit Address	
RLS Location Protocol	EPIRB	X
	ELT	X
	PLB	X
User Location Protocol	Maritime with MMSI	
	Maritime with Radio Call Sign	
	EPIRB Float Free with Serial Number	
	EPIRB Non Float Free with Serial Number	
	Radio Call Sign	
	Aviation	
	ELT with Serial Number	
	ELT with Aircraft Operator and Serial Number	
	ELT with Aircraft 24-bit Address	
	PLB with Serial Number	

Other Declarations	Declared Value	
Beacon includes a homer transmitter(s) (Yes or No)	Yes	
- homer transmitter(s) frequency and power	Frequency	Power (dBm)
	121.5 MHz	17
	243.0 MHz	N/A
	AIS	N/A
	Other (MHz)	
	<< frequency >>	N/A
	Description:	N/A
homer transmitter(s) duty cycle	96	%
duty cycle of homer swept tone	33	%
Beacon includes a high intensity flashing light (e.g. Strobe)	Yes	
- light intensity	36.75 white light	cd
- flash rate	6	flashes per minute
Beacon transmission repetition period satisfies C/S T.001 requirement that two beacon's repetition periods are not synchronised closer than a few seconds over 5 minute period, and the time intervals between transmissions are randomly distributed on the interval 47.5 to 52.5 seconds (Yes or No)	Yes	
Other ancillary devices (e.g. voice transceiver, remote control, external audio and light indicators, external activation device). List details on a separate sheet if insufficient space to describe.	N/A	
Beacon includes automatic activation mechanism (Yes or No). Specify type of automatic beacon activation mechanism	Yes / No :	No
	Description:	N/A
Beacon includes a voice-transceiver (Yes or No) - provides prevention against continuous operation of voice transmitter (Yes or No), and if Yes specify:	Yes / No :	No
	If Yes, specify:	N/A
- maximum continuous voice-transmission duration (limit), minutes	Limit (minutes):	N/A
- Manufacturer-specified total duration of voice-transmitter operation during the Manufacturer-declared minimum operating lifetime lifetime ("On time"), (hrs)	On time (hours):	N/A
Beacon includes features and functions not listed above, related or non-related to 406 MHz (Yes or No). List features and use a separate sheet if insufficient space	No	
	Description:	N/A
Beacon model hardware part number (P/N) and version	PLB-410: A3-06-3138-3 Rev D PLB-435: A3-06-3138-2 Rev D	
Beacon model firmware P/N, version, date of issue/releases	K3-01-0145 Rev E	
Beacon model software P/N, version, date of issue/releases	K3-01-0145 Rev E	

Beacon model printed circuit board P/N and version	PLB-410: A3-07-0472-2 Rev D PLB-435: A3-07-0469-2 Rev F	
Beacon model multiple programmable options, except message coding protocols (Yes/No)	No	
	If Yes, List all programmable options associated with this type-approval application:	N/A N/A N/A N/A
Known non-compliances with C/S T.001 requirements (Yes or No). If Yes, provide details (Submit C/S T.007 Section 5, part t, if applicable)	No	
Beacon Manufacturer Point of Contact (POC) for this Type Approval application:		
Name and Job Title:	Dan Stankovic, Director of Certification and Test	
Phone:	954-981-3333	
E-mail:	dan.stankovic@acrartex.com	

Dated(*)	05/31/2019
Signed(*)	
(Name, Position and Signature of Beacon Manufacturer Representative)	Dan Stankovic, Director of Certification and Test

Information Provided by the Cospas-Sarsat Accepted Test Facility

Name and Location of Beacon Test Facility: TÜV SÜD, United Kingdom

Date of Submission for Testing: 03 June 2019

Applicable C/S Standards:

Document	Issue	Revision	Date
C/S T.001	4	4	Feb 2019
C/S T.007	5	3	Feb 2019
IP (TCXO)	-	5	October 2013

I hereby confirm that the 406 MHz beacon described above has been successfully tested in accordance with the Cospas-Sarsat Type Approval Standard (C/S T.007) and complies with the Specification for Cospas-Sarsat 406 MHz Distress Beacons (C/S T.001) as demonstrated in the attached report

Detail any observed non-compliances and/or deviations from standard test procedures here:

Non-compliances:

None.

Deviations:

Item 18 - Return Link Service (RLS)

For A.3.8.8.1 and A.3.8.8.2:

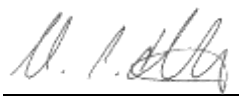
The test was performed inside an anechoic chamber using a GNSS Simulator capable of sending RLM to the EUT. The RLS messages were not monitored hence the first item in part a) RLS indication – could not be verified.

For A.3.8.8.2:

UTC Output GNSS receiver reactivation time (TP-18, A.3.8.8.2. h) and k)): the limit states that the reactivation time should be 52 mins +/- 5 seconds. The manufacturer states that the critical aspect of this test is that the receiver should be on at this point and not necessarily activated at this point. See Annex B for further information.

Notes:

None.

Signed: 

Name: Martin Hardy

Position Held: Authorised Signatory

Date: 12 January 2021

1.3 PRODUCT INFORMATION

1.3.1 Technical Description

The Equipment Under Test (EUT) was an ACR Electronics Inc PLB-410 as shown in the photograph below. A full technical description can be found in the manufacturer's documentation.

Equipment Under Test

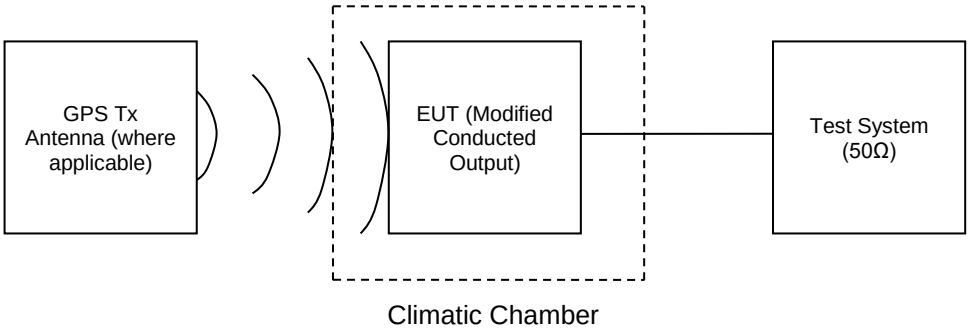
1.3.2 Physical Test Configuration

The Equipment Under Test (EUT) was operated using its own power source (internal battery). One EUT was configured so that the antenna port was connected to the 50Ω test system using a coaxial cable. The test configuration for all tests is identical Satellite Qualitative and Position Acquisition Time.

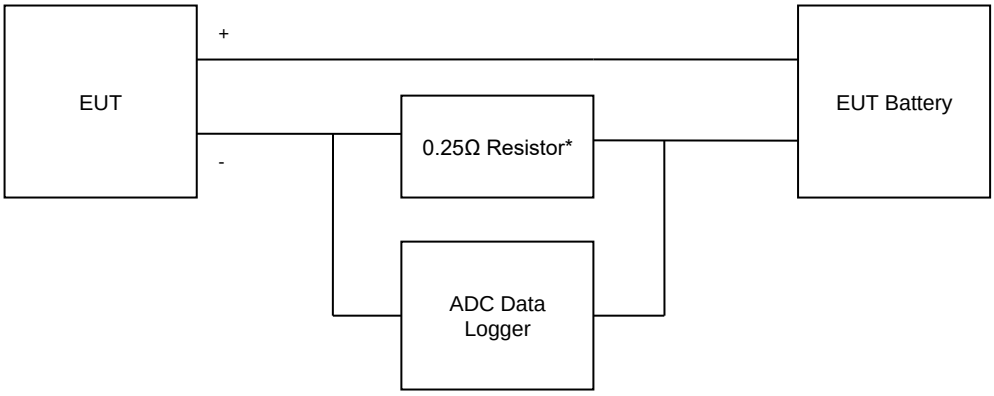
The second EUT was a fully packaged beacon, similar to the proposed production beacons equipped with its proper antenna. This EUT was used to perform Satellite Qualitative. The test configuration for this test is a function of the beacon type and the operational environments supported by the beacon, as declared by the manufacturer.

System Configurations

Conducted Laboratory Tests



Battery Current Measurements



Note: The resistor in series with negative line of battery

* Removed for Standby mode measurements
For Satellite the Qualitative test configuration, see photographs in section 4 of this report.

Further Information

Battery current measurements (see ‘Operating lifetime’, section 2.6) concluded that the ‘worst case’ (highest current) operating mode of the EUT was TUV Ref: A4 – ON at EUT, GPS Search / GPS Off in normal operating duty cycle. All tests were carried out in this mode unless otherwise stated.

The EUT is fitted with an internal GPS receiver. From cold start, without GPS signal data present, the duty cycle of the receiver is as described in the manufacturer information (refer to TUV SUD document 75943114 report 01). After a 15-minute warm up, electrical and functional tests were carried out for 20 minutes to ensure that measurements were made during periods when the GPS receiver was active and inactive.

The EUT includes a programming mode – for further details see manufacturer documentation and battery current measurements.

1.3.3 Modes of Operation

Modes of operation of the EUT during testing were as follows:

Off/Standby Mode
- Main Activation button to OFF position

Self-test
- Hold “TEST” button for >2 <5 seconds
- List of items checked as per Customer Supplied Information (Application Form)
- Navigation data applied at ambient temperature only

GNSS Self-test
- Hold “TEST” button for >5 <10 seconds
- List of items checked as per Customer Supplied Information (Application Form)
- Navigation data applied where applicable

Programming Mode
- Hold “TEST” button for >15 and <20 seconds until green LED flashes

Operating
- Hold Main activation button until red LED and strobe light flash
- 121 Homer active and offset to 121.65 MHz
- GPS operating in normal duty cycle
- No navigation data applied except where required (e.g., Navigation System Tests (Section 2.13))

All modes

All mode descriptions are applicable to all tests unless otherwise stated. There are no other means to activate the EUT.

1.4 TEST LOCATIONS

Satellite Qualitative: Daedalus Airfield, Lee-on-the-Solent, Hants, UK
All other tests: Octagon House Laboratory, Fareham, Hampshire, UK

1.5 MODIFICATIONS

Modification 0 - No modifications were made to the test sample during testing.

PLB-435 S/N: 9 C/S (75946138 TSR0005) – Modification State 1 (RLM reception verification tests only): this sample was modified to disconnect the display thus making it a PLB-410. Modification carried out by TUV SUD.

1.6 REPORT MODIFICATION RECORD

Issue 1 – First Issue
Issue 2 – Second Issue to update:
- Application Form
- Beacon Coding Software (BCS) and Position Data Encoding (PDE) report provided by ACR Electronics, Inc.
- Statements and Descriptions
- Description of Operating Modes

Issue 3 – Thirds Issue to update:
- Statement for A.3.8.8.2 in Deviations section

Issue 4 – Annex information corrected as per worksheet request

SECTION 2

TEST DETAILS

Emergency Beacons Testing of the
ACR Electronics Inc
PLB-410

TEST RESULTS TABLE

Parameters to be Measured	Range of Specification	Units	Test Results		Comments
10. Operating Lifetime at Minimum Temperature					**Result: Pass**
Model: PLB-410, S/N: 1 C/S, TUV Ref: TSR3 and Modification State 0					
Pre-test battery discharge duration (operating) required		Hours	3.67		
Pre-test battery discharge duration (operating)		Hours	3.75		
Duration	>24	Hours	25.99 Hours at Tmin = -20°C		Time to first failure.
Effective Operating Lifetime duration	>24	Hours	25.99 Hours at Tmin = -20°C		
Transmitted Frequency			Min	Max	Min/Max results are up to the manufacturer declared lifetime of 24hrs. MTS results exclude the first 30 mins of data (included in the test results section of this report).
Nominal value	C/S T.001	MHz	406.0310120	406.0310222	
Short-term stability	≤ $2x10^{-9}$	/100ms	4.756E-11	1.274E-10	
Medium-term stability – Slope	(-1 to +1)$x10^{-9}$	/min	-1.398E-10	1.876E-10	
Medium-term stability – Residual frequency variation	≤ $3x10^{-9}$		6.083E-11	5.047E-10	
Transmitter power output	35 - 39	dBm	35.75	37.16	
Digital message	correct	P/F	P		
Homer transmitter continuous operation during the lifetime test		hours	33.45		
			Start of Test	End of Test	'End of test' results are up to the manufacturer declared lifetime of 24hrs.
Homer frequency		MHz	121.496	121.496	
Homer peak power level		dBm	16.5	16.6	
Homer transmitter duty cycle		%	94.9	94.7	

Parameters to be Measured	Range of Specification	Units	Test Results				Comments
14. Satellite Qualitative Tests							**Result: Pass**
Model: PLB-410, S/N: 2 C/S, TUV Ref: TSR1 and Modification State 0							
Test Configuration	As per C/S T.007		Configuration				
			5	6	7	8	
15 Hex ID Decoded by LUT	correct	P / F	-	-	-	P	
Doppler Location results with error ≤ 5km	≥ 80	%	-	-	-	96.3	

Parameters to be Measured	Range of Specification	Units	Test Results			Comments
17. Navigation System						**Result: Pass**
Model: PLB-410, S/N: 2 C/S, TUV Ref: TSR1 and Modification State 0 **Model: PLB-410, S/N: 1 C/S, TUV Ref: TSR3 and Modification State 0**						
Location protocol	C/S T.001		RLS	-	-	
Position data default values	correct	P / F	P	-	-	
Configuration 7						
Position accuracy - A.3.8.2.1	C/S T.001	m	38.02	-	-	
Position Acquisition Time - A.3.8.2.1	<10/1	min	0.86	-	-	
Position accuracy - A.3.8.2.2	C/S T.001	m	46.83	-	-	
Position Acquisition Time - A.3.8.2.2	<10/1	min	0.86	-	-	
Configuration 8						
Position accuracy - A.3.8.2.1	C/S T.001	m		-	-	
Position Acquisition Time - A.3.8.2.1	<10/1	min	38.02	-	-	
Position accuracy - A.3.8.2.2	C/S T.001	m	0.86	-	-	
Position Acquisition Time - A.3.8.2.2	<10/1	min	46.83	-	-	
Encoded position data update interval	>5	min	0.86	-	-	
Position clearance after deactivation	cleared	P / F	P	-	-	
Position data input update interval (as applicable)	20/1	Min	N/A	-	-	
Position data encoding	correct	P / F	P	-	-	Manufacturer Supplied Data: see Annex A
Retained last valid position after navigation input lost	240(±5)	min	240.22	-	-	
Default position data transmitted after 240(±5) minutes without valid position data	cleared	P / F	P	-	-	
Information on protection against beacon degradation due to navigation device, interface or signal failure or malfunction	provided	Y / N	Y			Applicant's data, see Annex A for details

Parameters to be Measured	Range of Specification	Units	Test Results	Comments
18. Return Link Service (RLS)				**Result: Non-compliance***
Model: PLB435* S/N: 9 C/S (75946138 TSR0005) – Modification State 1 (RLM verification tests only)* ***See section 1.5 for details**				
A.3.8.8.1 Moffset Test – Config 8 Above Ground				
Self-Test for correct 15 Hex ID	193BFCE031BFDFF	N/A	Pass	
a) RLS Indication RLS request unique distinct indication	≤ 5 seconds after activation, until a valid RLM Type 1 or Test RLM message is received	s	4	
RLS indication is readily visible to the user when the beacon is operated in all declared operational configurations	Must be correct	P/F	P	
RLS indication is clearly visible to the user in direct sunlight, at a distance of 1 meter from the beacon.	Must be correct	P/F	P	
RLS indication remain inactive at all times when the beacon is encoded with any protocol other than RLS Location Protocol or RLS Location Test Protocol;	Must be correct	P/F	N/T	
Distinct indication that the RLM Type- 1 or Test RLM has been received	< 5 sec, after the RLM has been received until either the beacon is deactivated or the beacon battery is expired	s	2	RLM indication turns on at 00:02:48 U blox software equivalent time stamp should be 09:08:49 U blox actual RLM reception time stamp 09:08:51
The beacon only provides the indication of receipt of the RLM Type 1 or Test RLM, which contain the beacon 15 Hex ID	Must be correct		N/T	
b) Transmitted Message Bits 109 – 114	100001	N/A	100001	36 Hex message: FFFE2F8C9DFE7018CC9014D3B1B8601E0A49
c) GNSS Receiver turns on	≤ 5 seconds after first transmission	s	1	* GNSS receiver activates at beacon start up.

Parameters to be Measured	Range of Specification	Units	Test Results	Comments
d) Time to output UTC	Record time since receiver activation	s	28	
e) GNSS Receiver on time	≥ 30 minutes after beacon activation	min		Stopped after actions in g) fulfilled
f) Time to indicate RLM receipt	≤ 30 minutes after beacon activation	min	00:02:41	
g) Transmitted Message Bits 109 to 114	101001	N/A	101001	36 Hex message: FFFE2F8C9DFE7018CC9014D3B1BA601E068D
h) GNSS Receiver reactivation time	52 minutes +/- 5 seconds past next natural hour	min		Stopped after actions in g) fulfilled
i) GNSS Receiver on time	≥ 15 minutes after reactivation	min		Stopped after actions in g) fulfilled
j) GNSS Receiver reactivation time	52 minutes +/- 5 seconds past next natural hour	min		Stopped after actions in g) fulfilled
k) GNSS Receiver on time	≥ 15 minutes after reactivation	min		Stopped after actions in g) fulfilled
Deviation from the Standard Note: The test was performed inside an anechoic chamber using a GNSS Simulator capable of sending RLM to the EUT.				

Parameters to be Measured	Range of Specification	Units	Test Results	Comments
A.3.8.8.2 UTC Test - Config 8 Above Ground				**Result: Non-compliance****
a) Visual Indication	≤ 5 seconds after activation	sec	4	
b) Transmitted Message Bits 109 to 114	100001	N/A	Pass	36 Hex message: FFFE2F8C9DFE7018CC9014D3B1B8601E0A49
c) GNSS Receiver turns on	≤ 5 seconds after first transmission	s	*1	* GNSS receiver activates at beacon start up.
d) Time to output UTC	Record time since receiver activation	s s	9 11	00:00:59 – Wrong UTC – 00:00:04 00:01:01 – Correct UTC – 10:14:55
e) GNSS Receiver position output Deny Beacon further GNSS signals	Valid Lat/Long No further receiver outputs	N/A N/A	Pass Pass	
f) Transmitted message valid location Message Bits 109 to 114	≤ 500m of actual beacon location 100001	m N/A	23.81 Pass	Actual Position: N 50° 0', W 1° 14' Encoded Position: N 50°0, W 1° 13.98' Position Error: 23.81 m 36 Hex message: FFFE2F8C9DFE7018CC9014D3B1B8601E0A49
g) GNSS Receiver on time	≥ 30 minutes after beacon activation	min	00:52:34	Turned off at 11:07:29
h) GNSS Receiver reactivation time	52 minutes +/- 5 seconds past next natural hour	min	Pass*	Reactivation Time: 11:51:30 ** The Pass (with deviation to the standard) is awarded when considered alongside the ACR Electronics Document (Annex C)
i) GNSS Receiver on time	≥ 15 minutes after reactivation	min	00:16:29	Stopped 12:07:29
j) Transmitted message valid location Message Bits 109 to 114	≤ 500m of actual beacon location 100001	m N/A	23.81 Pass	Actual Position: N 50° 52.1423', W 1° 14.6799' Encoded Position: N 50° 0', W 1° 13.98' Position Error: 23.81m 36 Hex message: FFFE2F8C9DFE7018CC9014D3B1B8601E0A49
k) GNSS Receiver reactivation time	52 minutes +/- 5 seconds past next natural hour	min	Pass*	GNSS Reactivation at 12:51:29 ** The Pass (with deviation to the standard) is awarded when considered alongside the ACR Electronics Document (Annex C)

m) GNSS Receiver on time	≥ 15 minutes after reactivation	min	N/A	15 min period does not apply as the RLM was received at 12:52:52 and beacon only accepts Type-1 RLM.
n) Time to indicate RLM receipt	≤ 15 minutes after receiver reactivation	min	00:11:20	
o) Transmitted Message Bits 109 to 114	101001	N/A	101001	
Deviation from the Standard Note: The test was performed inside an anechoic chamber using a GNSS Simulator capable of sending RLM to the EUT.				

2.1 OPERATING LIFETIME AT MINIMUM TEMPERATURE

2.1.1 Specification

Cospas-Sarsat T.007, Clause A.2.3

2.1.2 Equipment Under Test and Modification State

PLB-410 S/N: 1 C/S - Modification State 0

2.1.3 Date of Test

06 June 2019 and 16 July 2019

2.1.4 Test Equipment Used

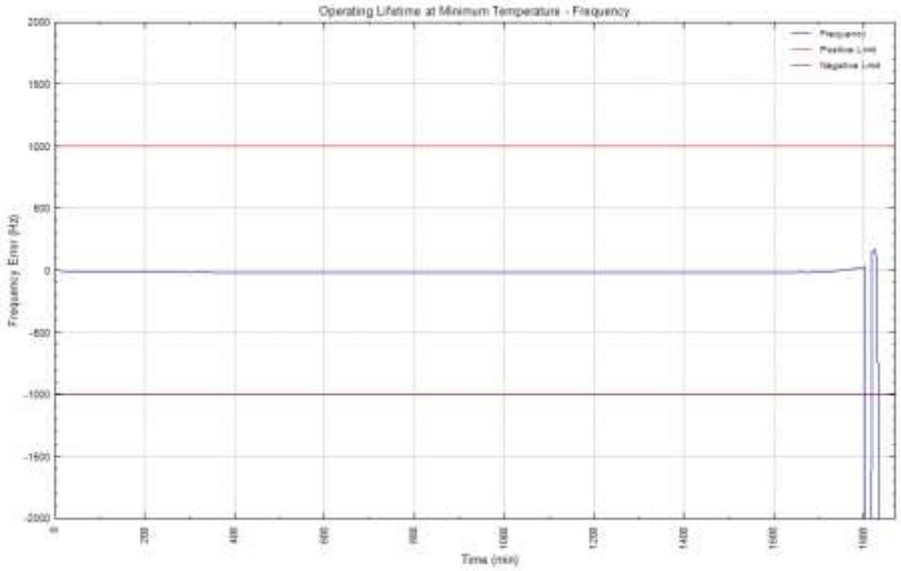
The major items of test equipment used for the above tests are identified in Section 3.1.

2.1.5 Environmental Conditions

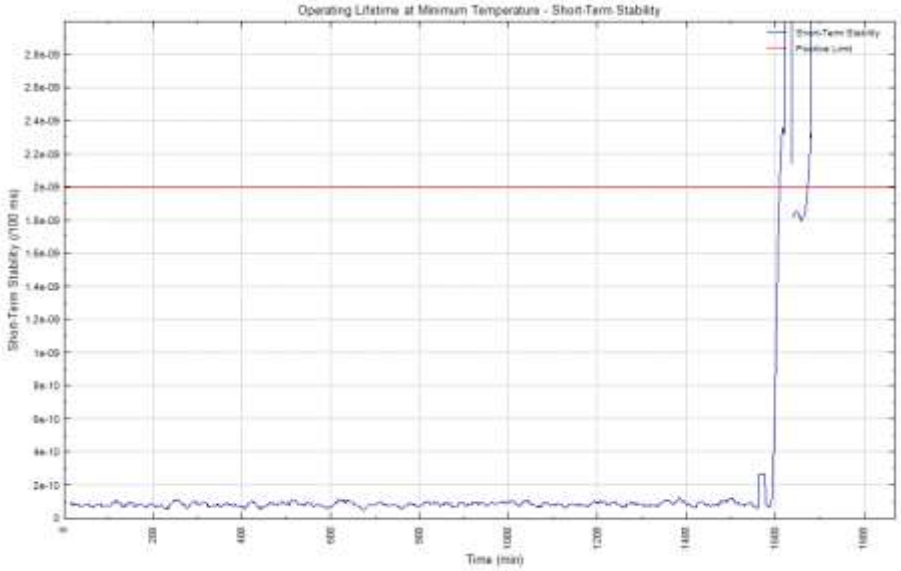
Ambient Temperature 21.5°C
Relative Humidity 37.8 to 44.8%

2.1.6 Test Results

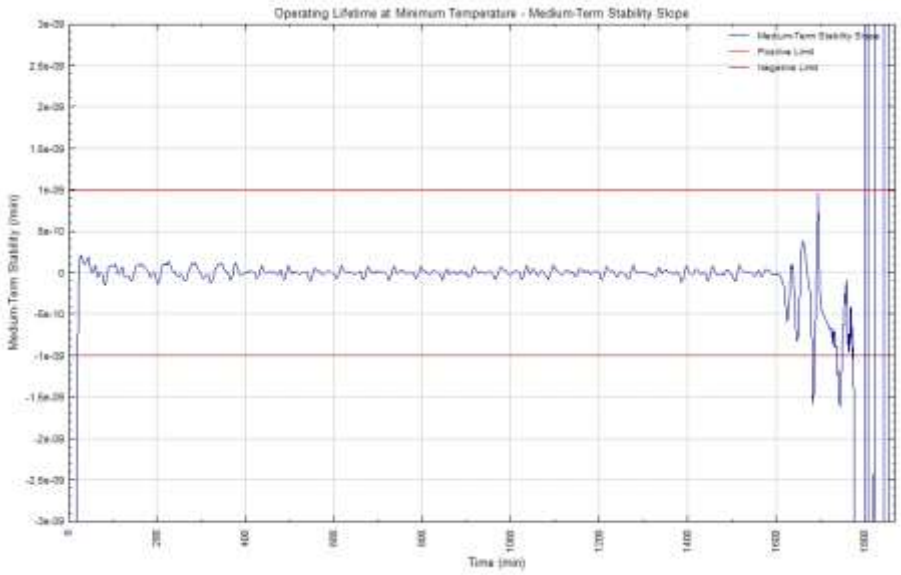
Nominal Frequency



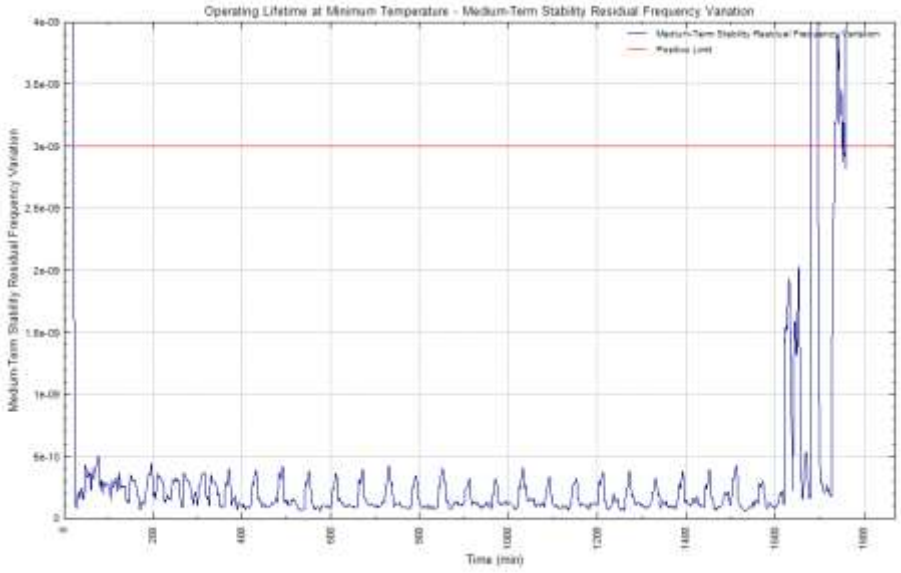
Short Term Stability



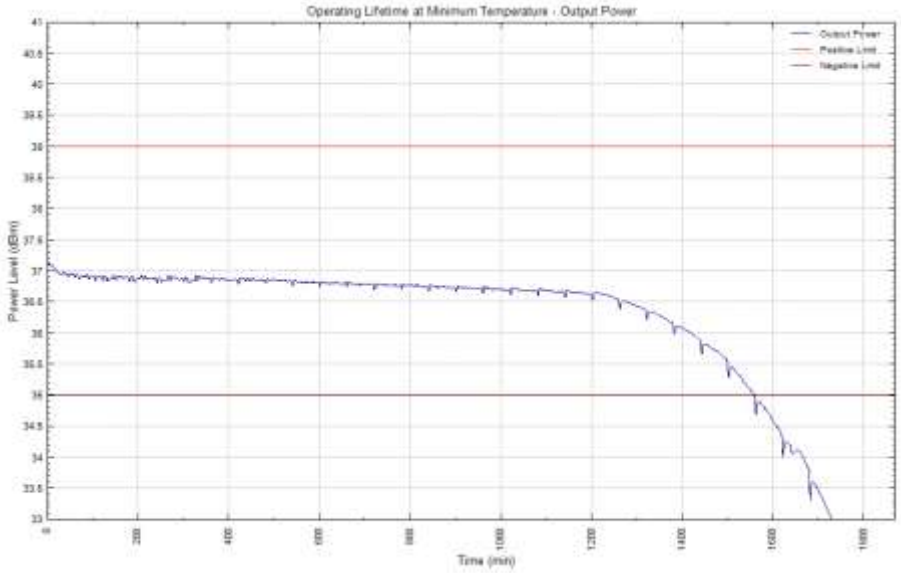
Medium Term Stability, Mean Slope



Medium Term Stability, Residual Frequency Variation



Output Power



Digital Message

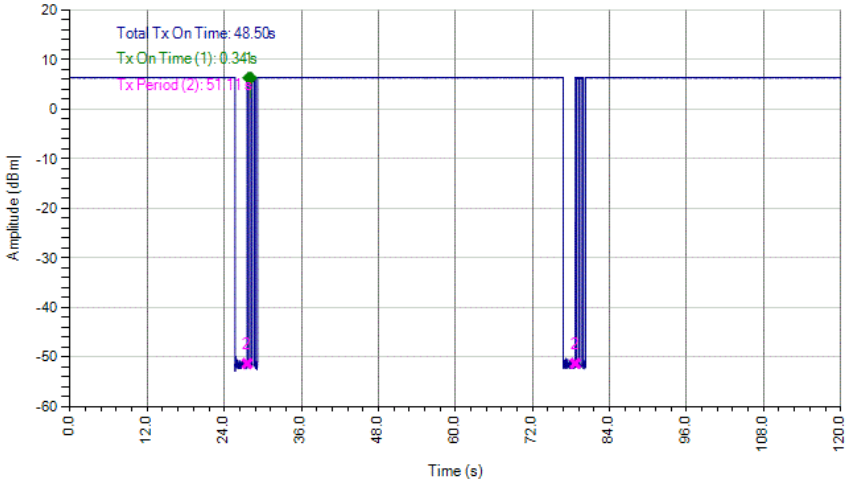
Message	FFFE2F8C9DFE7018DFEFF8129DF861F0FABE		
Hex ID	193BFCE031BFDFF		
Position	None - Default Values		
Parameter	Bit	Data Bits	Decoded Value
Bit synchronization	1-15	111111111111111	111111111111111
Frame synchronization	16-24	101111	101111
Format Flag	25	1	1
Protocol Flag	26	0	0
Country Code	27-36	11001001	Albania (Republic of)
Protocol Code	37-40	1101	RLS Location Protocol
Beacon Type	41-42	11	Location Test Protocol
RLS TAC	43-52	1111100111	999
RLS ID Serial Number	53-66	1100011	99
N/S	67	0	North
Latitude Degrees	68-75	11111111	127.5
E/W	76	0	East
Longitude Degrees	77-85	111111111	255.5
BCH Code (21 Bit)	86-106	00000010010100111011	00000010010100111011
Encoded Position Data Source	107	1	Internal navigation device
121.5 MHz Radio Locating Device	108	1	Yes
Capability to process RLM Type-1:	109	1	Acknowledgement Type-1 accepted by this beacon
Capability to process manually generated RLM	110	0	Manually generated RLM not accepted by this beacon
Feedback on RLM Type-1:	111	0	Acknowledgement Type-1 not (yet) received by this beacon
Feedback on RLM Type-2	112	0	RLM Type-2 not (yet) received by this beacon
RLS Provider Identification:	113-114	1	-
Delta Latitude	115	1	Default
Delta Latitude Minutes	116-119	0	Default
Delta Latitude Seconds	120-123	1111	Default
Delta Longitude	124	1	Default
Delta Longitude Minutes	125-128	0	Default
Delta Longitude Seconds	129-132	1111	Default
BCH Code (12 Bit)	133-144	101010111110	101010111110

Test Data (0 min - 30 min)

#	Output Power (dBm)	Nominal Frequency (Hz)	Short Term Stability (/100 ms)	Medium Term Stability – Slope (/min)	Medium Term Stability – Residual Frequency Variation (no units)	Time (h)
1	37.16	-	-	-	-	0.000
2	37.16	-	-	-	-	0.014
3	37.11	-	-	-	-	0.028
4	37.09	-	-	-	-	0.042
5	37.09	-	-	-	-	0.056
6	37.1	-	-	-	-	0.069
7	37.09	-	-	-	-	0.083
8	37.09	-	-	-	-	0.097
9	37.08	-	-	-	-	0.111
10	37.09	-	-	-	-	0.125
11	37.1	-	-	-	-	0.139
12	37.11	-	-	-	-	0.152
13	37.08	-	-	-	-	0.165
14	37.07	-	-	-	-	0.179
15	37.07	-	-	-	-	0.194
16	37.07	-	-	-	-	0.207
17	37.06	-	-	-	-	0.221
18	37.06	406.03102	1.00E-10	-6.42E-09	1.11E-08	0.235
19	37.04	406.03102	9.17E-11	-5.54E-09	1.14E-08	0.248
20	37.04	406.03102	8.01E-11	-4.59E-09	1.10E-08	0.262
21	37.02	406.03102	7.98E-11	-3.68E-09	1.02E-08	0.276
22	37.01	406.03102	7.73E-11	-2.82E-09	8.99E-09	0.290
23	37.02	406.03101	7.71E-11	-2.03E-09	7.37E-09	0.304
24	37.01	406.03101	8.29E-11	-1.35E-09	5.45E-09	0.318
25	36.99	406.03101	8.70E-11	-8.26E-10	3.76E-09	0.331
26	36.98	406.03101	8.36E-11	-4.85E-10	2.76E-09	0.344
27	36.98	406.03101	9.08E-11	-2.42E-10	2.09E-09	0.358
28	36.97	406.03101	8.44E-11	-5.57E-11	1.41E-09	0.372
29	36.97	406.03101	8.57E-11	7.52E-11	8.38E-10	0.386
30	36.98	406.03101	8.09E-11	1.53E-10	4.04E-10	0.400
31	36.97	406.03101	8.84E-11	1.94E-10	1.74E-10	0.414
32	36.96	406.03101	8.77E-11	2.06E-10	1.02E-10	0.429
33	36.94	406.03101	8.30E-11	2.12E-10	8.22E-11	0.442
34	36.96	406.03101	8.27E-11	2.02E-10	1.12E-10	0.457
35	36.94	406.03101	8.26E-11	1.95E-10	1.41E-10	0.471
36	36.94	406.03101	8.22E-11	1.83E-10	1.75E-10	0.484
37	36.95	406.03101	8.18E-11	1.69E-10	1.81E-10	0.498
38	36.95	406.03101	8.18E-11	1.54E-10	1.98E-10	0.512

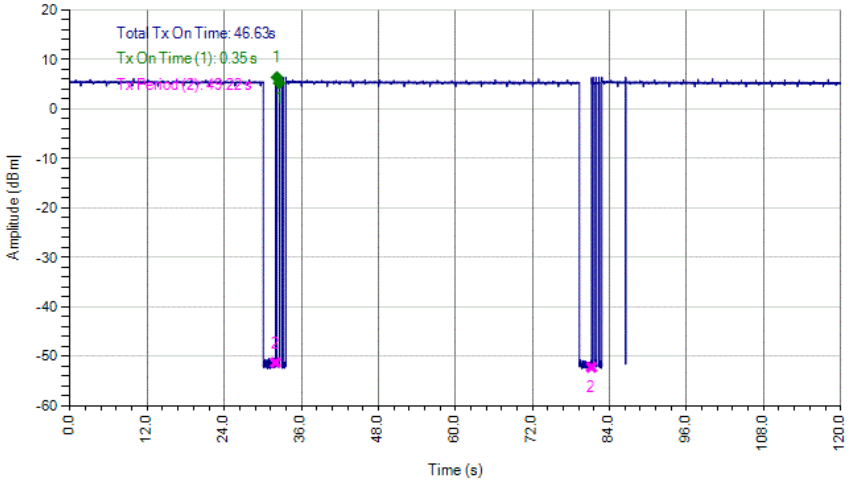
Results outside of the specification are marked in red text.

121MHz Homing Transmitter - Duty Cycle (Start of Test)



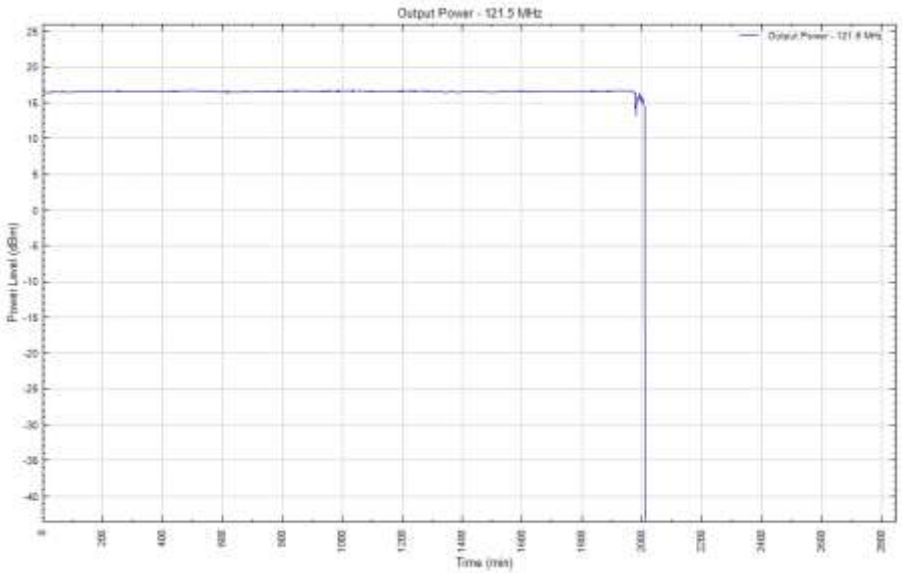
Duty Cycle = 48.50 / 51.11 = 94.9%

121MHz Homing Transmitter - Duty Cycle (End of Test)

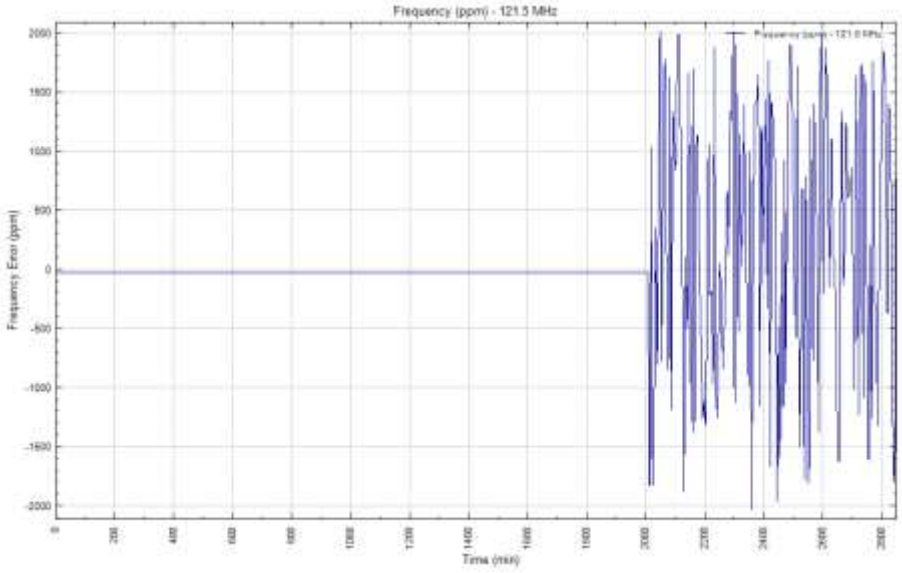


Duty Cycle = 46.63 / 49.22 = 94.7%

121MHz Homing Transmitter Power



121MHz Homing Transmitter Frequency



2.1.7 Test Results

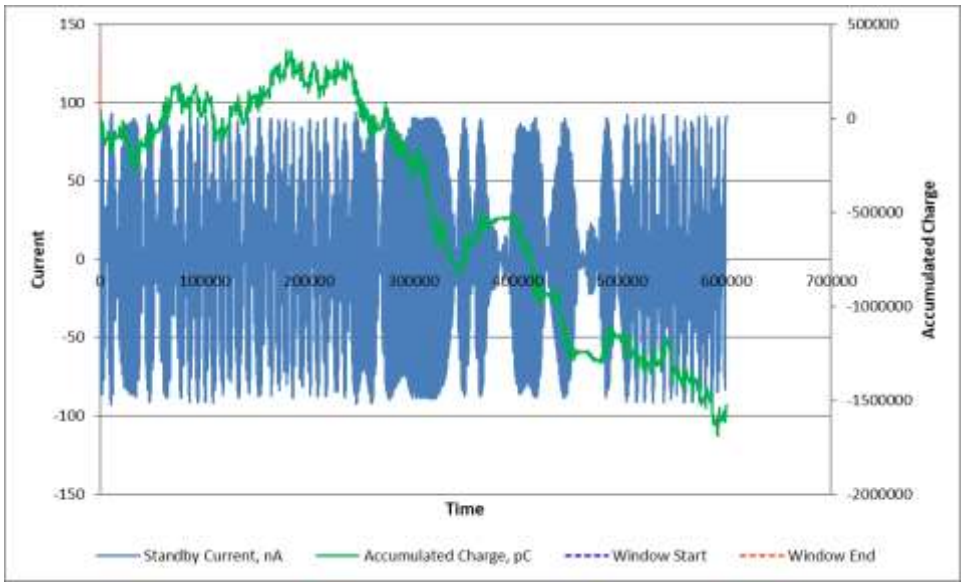
Operating Current Measurements and Analysis

Table F.E-1

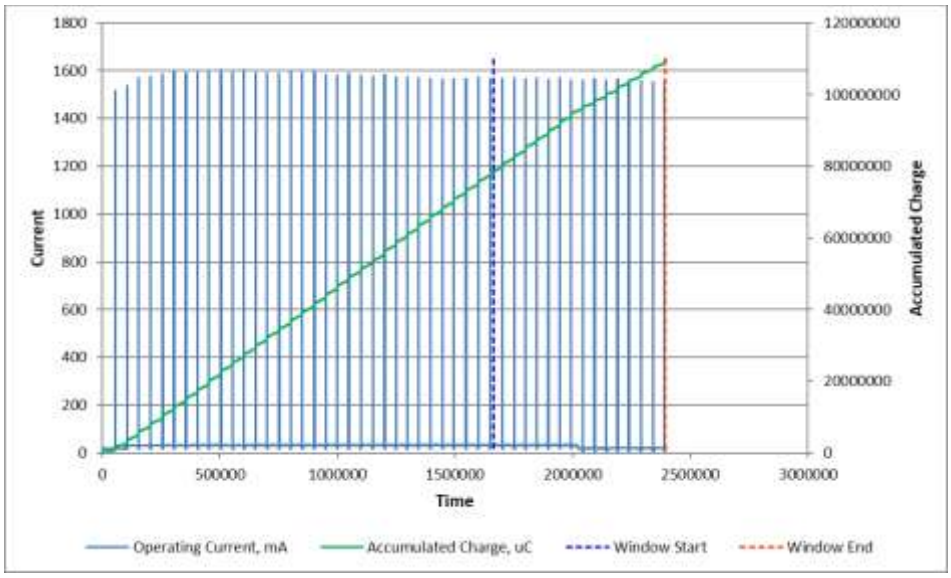
System Configuration ➔ Operational Mode ↓	A, No Ancillaries
1, Standby	**A1**
2, ON at EUT switch (GPS Search)	**A2**
3, ON at EUT (GPS Sleep)	**A3**
4, ON at EUT (Average)	**A4**
5, Self-test	**A5**
6, GNSS Self-test	**A6**
7, Programme Mode (Self-Test button Held)	**A7**
8, Programme Mode (Self-Test button Released)	**A8**

Beacon Operating Modes	Mode: Manually selectable or Automatic	Measurement interval, sec	Average Current, mA	Peak Current, mA
A1	A	0.078	0.0000025	0.0000934
A2	M	1924	48.33	1604
A3	M	364.50	38.41	1566
A4	M	729	42.63	1571
A5	M	13.85	72.74	1538
A6	M	106.90	27.76	1497
A7	M	30.41	18.97	21.63
A8	M	54.40	19.79	24.03

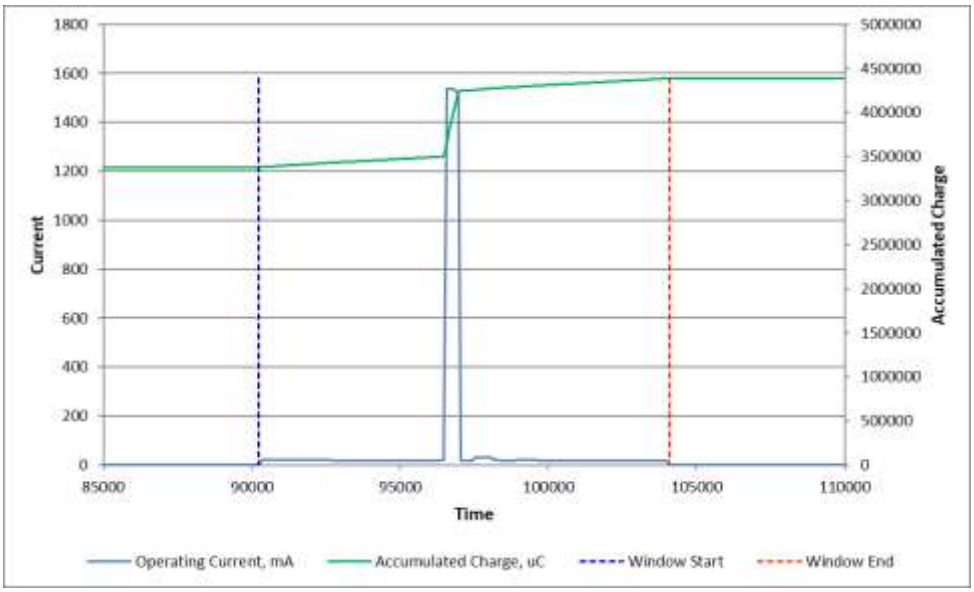
Current Measurement Plots



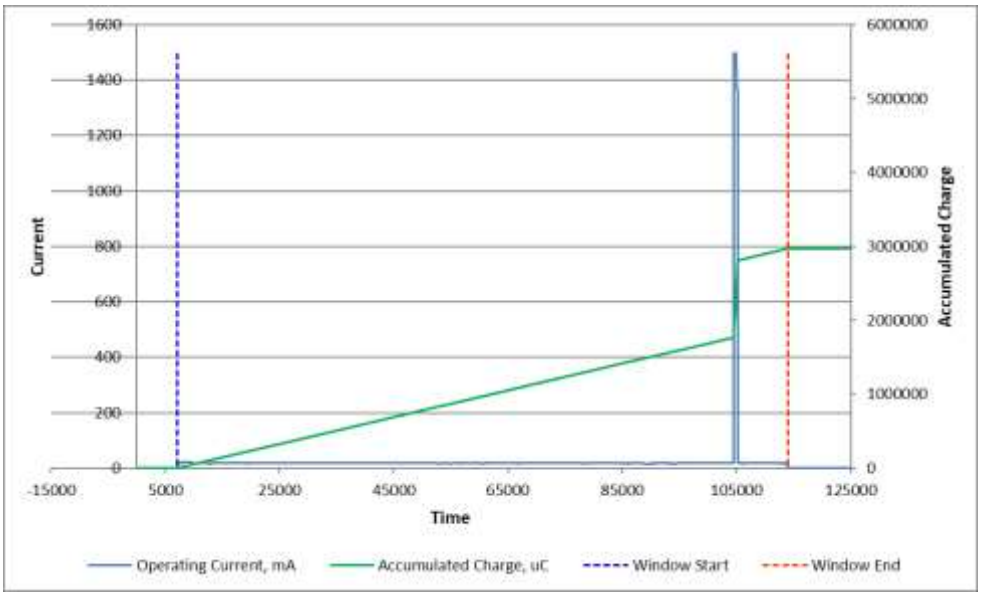
Standby: A1



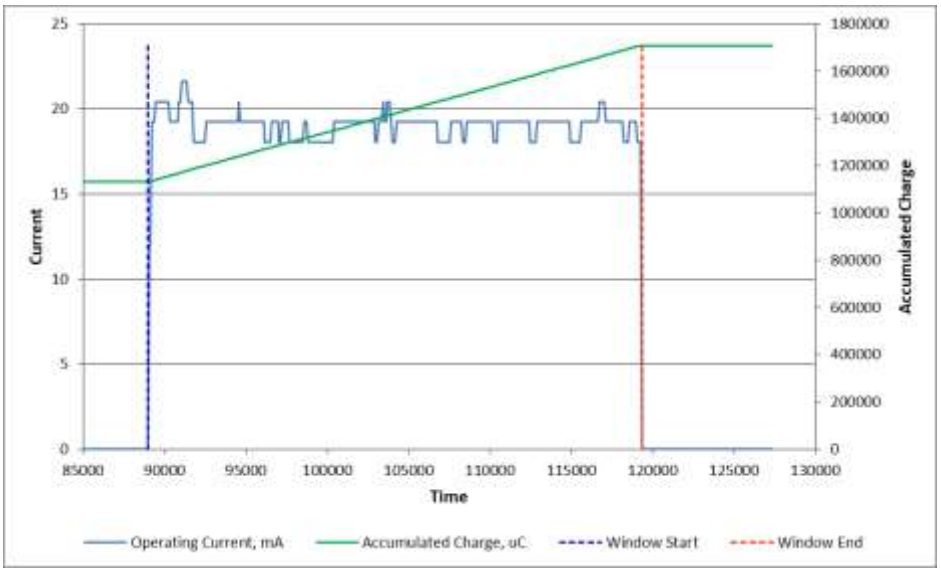
Operating: A4



Self-test: A5

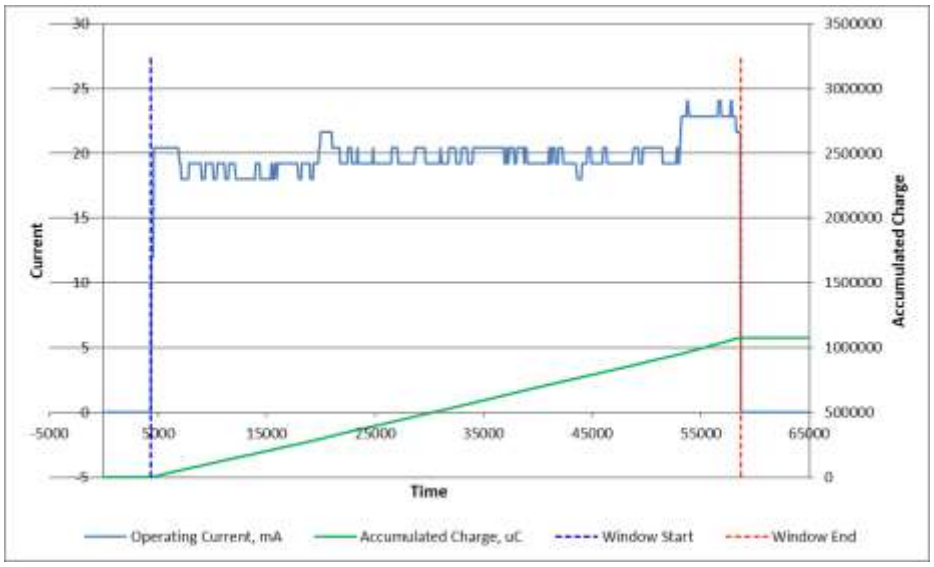


GNSS Self-test (Timeout): A6



Self-Test button continuously held in the 'On' position: A7

NOTE: If the Self-Test button is continuously held, the EUT will function as A7 above (i.e. the EUT will enter programming mode). However, the EUT will power down approximately 30 seconds after activation. Therefore, the worst case is when the Self-Test button is released after the EUT enters programming mode as indicated by the green EUT LED as shown in A8 below.



Self-Test button released after entering Programme Mode: A8

Table F.E-2

Characteristic	Designation	Units	Value	Comments
Beacon manufacturers declared maximum allowed cell shelf-life (from date of cell manufacture to date of battery pack installation in the beacon)	T_{CS} or TCS	Years	1	
Declared beacon battery replacement period (from date of installation in the beacon to expiry date marked on the beacon)	T_{BR} or TBR	Years	5	
Battery pack electrical configuration	-	-		
Cell model and cell chemistry	-	-		
Nominal cell capacity	-	Ah	1.4	
Nominal battery pack capacity	C_{BN}	Ah	1.4	
Annual battery cell capacity loss (self-discharge) due to aging, as specified by cell manufacturer at ambient temperature	L_{SDC}	%	1	
Calculated battery pack capacity loss due to self-discharge: $L_{CBN} = C_{BN} - [C_{BN} * (1 - L_{SDC}/100)^{TBR+TCS}]$	L_{CBN}	Ah	0.0819	
Number of self-tests per year	N_{ST}	-	12	
Average battery current during a self-test	I_{ST}	mA	72.74	
Maximum duration of a self-test	T_{ST}	s	14	Manufacturer Declared Value
Calculated battery pack capacity loss due to self-tests during battery replacement period: $L_{ST} = I_{ST} * T_{ST} * T_{BR} * (N_{ST} / 3600)$	L_{ST}	mAh	16.97	
Maximum Number of GNSS self-tests between battery replacements	N_{GST}	-	20	
Average battery current during a GNSS self-test of maximum duration	I_{GST}	mA	27.76	
Maximum duration of a GNSS self-test	T_{GST}	s	110	Manufacturer Declared Value
Calculated battery pack capacity loss due to GNSS self-tests during battery replacement period: $L_{GST} = I_{GST} * T_{GST} * (N_{GST} / 3600)$	L_{GST}	mAh	16.96	
Average stand-by battery pack current	I_{SB}	mA	0.0000009	
Other Capacity Losses	L_{OTH}	mAh	2.97	See Note below
Battery pack capacity loss due to constant operation of circuitry prior to beacon activation: $L_{ISB} = I_{SB} * T_{BR} * 8760$	L_{ISB}	mAh	0.1314	
Calculated value of the battery pack pre-test discharge $L_{CDC} = L_{CBN} + 1.65((L_{ST} + L_{GST} + L_{ISB})/1000) + (L_{OTH}/1000)$	L_{CDC}	Ah	0.1411	

Characteristic	Designation	Units	Value	Comments
Method of discharge	-	-	Pre-test Operating Duration	Mode A4
Discharge current	L_D	mA	38.41	Worst Case
Discharge duration, $T_D = L_{CDC} / (L_D * 1000)$	T_D	h	3.67	

Note: If the end user inadvertently enters programming mode (by holding the TEST button for >15s <20s**), the EUT will draw current for approximately 54 seconds before powering down with no further action (see manufacturer documentation for further details).
The average current during this time was measured as 19.79 mA. This equates to 0.29 mAh. The manufacturer has declared that this feature can only be accessed a maximum of 10 times - any further attempts cause no action from the EUT. Therefore, the overall maximum current drain = 0.29 mAh * 10 attempts = 2.97 mAh
** This is the worst case scenario - if the Test button is continuously held, the EUT will power down earlier, thereby drawing less overall current. See battery current measurement plots for details.

Battery Conditioning Results

A fresh battery was used for the test; it was discharged by operation inside the EUT for the pre-test discharge duration calculated as follows:

Pre-test discharge (L_{CDC}) [mAh] = 141.1

Operating mode current [mA] = 38.41

Pre-test discharge duration [h] = $\frac{141.1}{38.41}$

Pre-test discharge duration [h] = 3.67

The actual discharge duration was 3.75 h resulting in a discharge of 143.96 mAh; an over-test of 2.1 %.

Battery Current comparison measurements

Operating Mode	PLB-400 Modification State 0	PLB-410 Modification State 0	% Difference
	Average Current (mA)	Average Current (mA)	
1, Standby	0.0000008228	0.00000254	208.7
2, ON at EUT switch (GPS Search)	48.84	48.33	-1.04
3, ON at EUT (GPS Sleep)	35.35	38.41	8.66
4, ON at EUT (Average)	42.09	42.63	1.28
5, Self-test	75.8	72.74	-4.04
6, GNSS Self-test	25.02	27.76	10.95
7, Programme Mode (Self-Test button held)	18.56	18.97	2.21
8, Programme Mode (Self-Test button released)	19.56	19.79	1.18

Summary

The table above presents a comparison of battery current measurements between the PLB400 and the PLB-410.

The EUT complies with clause A.2.3 of Cospas-Sarsat T.007.

2.2 SATELLITE QUALITATIVE TESTS

2.2.1 Specification

Cospas-Sarsat T.007, Clause A.2.5

2.2.2 Equipment Under Test and Modification State

PLB-410 S/N: 2 C/S - Modification State 0

2.2.3 Date of Test

23 July 2019 to 24 July 2019

2.2.4 Test Equipment Used

The major items of test equipment used for the above tests are identified in Section 3.1.

2.2.5 Environmental Conditions

Ambient Temperature 17.8°C to 21.3°C
Relative Humidity 40.8 to 58.7%

2.2.6 Test Results

Date of the Test:	2019-07-23
Time of the Test:	15:00:54
Beacon Model:	PLB-410
Beacon 15-Hex ID:	1D7BFCE03199A02
Location of Test:	Daedalus Survey
Actual location Latitude:	50.814305
Actual location Longitude:	-1.2017598
Beacon test configuration:	8
Solutions within 5 km:	26
Number of Satellite Passes:	27
Ratio of Successful Solutions:	96.3 %

Satellite ID	Satellite Pass	TCA Date	TCA Time	Cross Track Angle	15 Hex ID	Doppler Latitude	Doppler Longitude	Location Error (km)
12	53884	2019-07-23	15:00:54	11.771	1D7BFCE03199A02	50.821	-1.203	0.749
12	53885	2019-07-23	16:41:09	-3.048	1D7BFCE03199A02	50.819	-1.199	0.557
7	10224	2019-07-23	17:20:33	8.955	1D7BFCE03199A02	50.817	-1.198	0.399
12	53892	2019-07-24	04:57:48	-8.556	1D7BFCE03199A02	50.814	-1.203	0.093
12	53886	2019-07-23	18:22:53	-19.113	1D7BFCE03199A02	50.818	-1.2	0.429
12	53893	2019-07-24	06:38:32	6.897	1D7BFCE03199A02	50.816	-1.206	0.352
7	10232	2019-07-24	07:09:49	-5.823	1D7BFCE03199A02	50.816	-1.202	0.189
7	10225	2019-07-23	19:00:12	-6.18	1D7BFCE03199A02	50.824	-1.206	1.118
12	53894	2019-07-24	08:17:53	19.874	1D7BFCE03199A02	50.815	-1.206	0.308
13	35521	2019-07-23	22:15:29	-13.238	1D7BFCE03199A02	50.821	-1.203	0.749
13	35520	2019-07-23	20:34:53	2.521	1D7BFCE03199A02	50.826	-1.201	1.301
13	35519	2019-07-23	18:55:42	16.467	1D7BFCE03199A02	50.826	-1.21	1.423
11	66205	2019-07-23	21:00:52	-5.53	1D7BFCE03199A02	50.829	-1.204	1.641
13	35527	2019-07-24	08:46:23	-14.341	1D7BFCE03199A02	50.816	-1.203	0.208
12	53898	2019-07-24	14:49:23	13.345	1D7BFCE03199A02	50.813	-1.199	0.242
12	53899	2019-07-24	16:29:28	-1.207	1D7BFCE03199A02	50.815	-1.203	0.116
7	10238	2019-07-24	16:55:44	12.424	1D7BFCE03199A02	50.818	-1.194	0.682
7	10233	2019-07-24	08:49:27	9.331	1D7BFCE03199A02	50.776	-1.14	6.078
12	53900	2019-07-24	18:11:01	-17.22	1D7BFCE03199A02	50.801	-1.204	1.487
7	10239	2019-07-24	18:35:03	-2.22	1D7BFCE03199A02	50.816	-1.214	0.880
11	66218	2019-07-24	19:00:27	12.451	1D7BFCE03199A02	50.818	-1.197	0.529
10	73062	2019-07-24	20:16:35	-1.918	1D7BFCE03199A02	50.815	-1.21	0.584
10	73061	2019-07-24	18:36:24	12.749	1D7BFCE03199A02	50.819	-1.2	0.536
11	66219	2019-07-24	20:40:05	-2.275	1D7BFCE03199A02	50.815	-1.208	0.445
13	35535	2019-07-24	21:54:33	-9.916	1D7BFCE03199A02	50.818	-1.203	0.420
13	35534	2019-07-24	20:14:15	5.617	1D7BFCE03199A02	50.821	-1.201	0.746
13	35533	2019-07-24	18:35:21	18.945	1D7BFCE03199A02	50.823	-1.205	0.993

Note: Hex ID provided by the LUT can be decoded back to the default Hex ID of 1D7BFCE031BFDFF, programmed to the EUT before test.

Location Errors greater than 5 km are marked in red text.

$$\text{Ratio of Successful Solutions} = \frac{\text{number of Doppler solutions within 5 km with 1°<CTA<21°}}{\text{number of satellite passes over test duration with 1°<CTA<21°}}$$

$$= \frac{26}{27}$$

$$= 96.3\%$$

Summary

The EUT complies with clause A.2.5 of Cospas-Sarsat T.007.

2.3 NAVIGATION SYSTEM TEST

2.3.1 Specification

Cospas-Sarsat T.007, Clause A.2.7

2.3.2 Equipment Under Test and Modification State

PLB-410 S/N: 1 C/S - Modification State 0
PLB-410 S/N: 2 C/S - Modification State 0

2.3.3 Date of Test

20 June 2019, 04 July 2019, 12 July 2019 and 23 to 24 July 2019

2.3.4 Test Equipment Used

The major items of test equipment used for the above tests are identified in Section 3.1.

2.3.5 Environmental Conditions

Ambient Temperature 27.4 – 32.0°C
Relative Humidity 33.9 – 57.2%

2.3.6 Test Results

RLS Protocol

Position Data Default Values (C/S T.007 A.3.8.1):

No position data was provided for > 4 hours before the test started. The beacon was activated and operated for 30 minutes without providing data. Message content was checked for all bursts during this period.

36 Hex Message	Message Count
FFFE2F8C9DFE7018DFEFF8129DF861F0FABE	36

Position Acquisition Time and Position Accuracy (C/S T.007 A.3.8.2)

Locations:

A.3.8.2.1:	50° 48.858'N	1° 12.106'W	①
A.3.8.2.2:	50° 52.142' N	1° 14.680'W	①

The appropriate position was applied, the EUT activated and time to first message containing valid position data timed.

Configuration as per C/S T.007	C/S T.007 Section A.3.8.2.1		C/S T.007 Section A.3.8.2.2	
	Time to Acquire Position (min)	Location Error in metres	Time to Acquire Position (min)	Location Error in metres
Configuration 7	0.86	38.02	0.86	46.83
Configuration 8	0.86	38.02	0.86	46.83

Positional accuracy was calculated using the Haversine Formula, The Earth's radius was taken as 6367 km.

① GPS Site Survey – Live Location

Encoded Position Data Update Interval (C/S T.007 A.3.8.3):

Location: N 50° 48.683' W 1° 37.417' ①		
Data Acquired at	07:47:08	FFFE2F8C9DFE7018CCD01C855BB856B76BC3
Location: N 51° 22.583' W 1° 49.833' ①		
Data Updated at	07:53:46	FFFE2F8C9DFE7018CCF024AD44F84ECA2A3C
Data Update Interval	6 min 38 s	

① Input from GPS simulator

Note: Position 2 applied immediately after the first EUT message encoded with position 1.

Encoded Position Data Update Interval (C/S T.007 A.3.8.3) – Long Test:

Locations: N 0° 00.000' E 0° 00.000' (Start location). The position changes by 20km every 4m 55s, moving in a NE direction (045 bearing). ①		
Parameter	Update interval	Limit
0 h to 2 h – Minimum	05:43	≥ 05:00
0 h to 2 h – Maximum	15:02	≤ 30:00
2 h to 6 h – Minimum	05:46	≥ 05:00
2 h to 6 h – Maximum	26:43	≤ 30:00
6 h to 24 h – Minimum	11:43	≥ 05:00
6 h to 24 h – Maximum	60:01	≤ 60:00*
Assessment	Result	
Results indicate that data changes as per C/S T.001 4.5.5.4 (Y/N)	Y	
Results indicate that data changes as per manufacturer's update scheme (Y/N)	Y	

① Input from GPS simulator

* In accordance with clause 4.5.5.4 of C/S T.001, the maximum limits between attempts by the navigation device to obtain location updates are 30 minutes in the first 6 hours of operation and 60 minutes between 6 hours and the declared operating lifetime.

Manufacturer supplied data shows that the navigation device is powered up, as per above mentioned schedule, for a maximum time of 3 minutes and 35 seconds at each attempt.

Therefore, the maximum time between encoded position updates is 30 minutes plus 3 minutes and 35 seconds during the first 6 hours of operation, and 60 minutes plus 3 minutes and 35 seconds between 6 hours after activation and the end of the declared operating lifetime.

Position Clearance After Deactivation (C/S T.007 A.3.8.4)

Following the Encoded Position Data Update Interval test, the beacon was deactivated and reactivated without providing navigation data. The Digital Message output was encoded with the default position data.

Position Data Input Update Interval (C/S T.007 A.3.8.5)

EUT does not accept external position input, test is not applicable.

Last Valid Position (C/S T.007 A.3.8.6)

Location: N 50° 52.1423' W 1° 14.679' ①		
Data Acquired at	10:31:31	FFFE2F8C9DFE7018CCD0153323784FBEA8E5
GPS Signal Navigation Data Removed		
Last Message with Encoded Data	14:31:53	FFFE2F8C9DFE7018CCD0153323784FBEA8E5
Data Updated at	14:32:45	FFFE2F8C9DFE7018DFEFF8129DF861F0FABE
Last Valid Position Held	240 min 22 s	
Return to Default Position	✓	

① GPS Site Survey – Live Location

Summary

The EUT complies to comply with clause A.2.7 of Cospas-Sarsat T.007.

SECTION 3

TEST EQUIPMENT USED

3.1 TEST EQUIPMENT

List of absolute measuring and other principal items of test equipment.

Instrument	Manufacturer	Type No.	TE No.	Calibration Period (months)	Calibration Due
Section 2.1 Beacons - Battery Current Measurements					
Load (50ohm/30W)	Weinschel	50T-054	285	12	15-Oct-2019
Termination (50ohm)	Diamond Antenna	DL-30N	337	12	14-Dec-2019
Hygromer	Rotronic	I-1000	2829	12	04-Dec-2019
8 Channel Datalogger + Terminal Board	Pico Technology Ltd	ADC-16	3287	12	08-Jan-2020
Variable Resistive Load	TUV SUD	n/a	5057	12	12-Dec-2019
Section 2.2 Beacons - Satellite Qualitative Test					
Beacon Tester	WS Technologies	BT 100S	87	-	TU
Hygrometer	Rotronic	HP21	4740	12	17-Jan-2020
Non Conductive Standoff Box	TUV SUD	Non Conductive Standoff Box	4966	-	TU
Section 2.1 Beacons - Operating Lifetime					
Climatic Chamber	Heraeus Votsch	VMT 04/30	40	-	O/P Mon
Power Meter	Hewlett Packard	436A	83	12	26-Sep-2019
Beacon Tester	WS Technologies	BT 100S	87	-	TU
Signal Generator	Hewlett Packard	8644A	96	12	09-May-2020
Beacon RF Unit	TUV SUD	N/A	97	-	TU
Spectrum Analyser	Agilent Technologies	E7405A	1410	12	13-Sep-2019
Hygromer	Rotronic	I-1000	2829	12	04-Dec-2019
Attenuator (3dB, 20W)	Aeroflex / Weinschel	23-03-34	3163	12	16-Jan-2020
Time Interval Analyser	Yokogawa	TA720 704510	3253	12	16-Nov-2019
Power Sensor	Agilent Technologies	8482A	3289	12	26-Apr-2020
DC - 4 GHz Attenuator	Narda	766F-3	3962	12	23-Apr-2020
Oscilloscope	Yokogawa	DL750	4552	12	08-Apr-2020
Bandpass Filter (1MHz)	KR Electronics	3219-SMA	4600	12	03-Sep-2019
Cable (18 GHz)	Rosenberger	LU7-036-1000	5027	-	O/P Mon
Cable (18 GHz)	Rosenberger	LU7-036-1000	5028	-	O/P Mon
Section 2.3 Beacons - Navigation System					
Antenna (Double Ridge Guide,1GHz-18GHz)	ETS-Lindgren	3117	4738	12	05-Mar-2020
Directional Coupler	Narda	3022	503	-	O/P Mon
Termination (50ohm, 6W)	Micronde	R404613	3074	12	05-Jun-2020
3dB/10W Attenuator	Texscan	HFP-50N	475	12	23-Apr-2020
Spectrum Analyser	Agilent Technologies	E4407B	1154	12	09-Oct-2019
Screened Room (1)	Rainford	Rainford	1541	-	TU
GPS/SBAS Simulator	Spirent	GSS6700	4596	12	16-Aug-2019
Copper GRP	TUV SUD Product Service	27cm Diameter	3538	-	TU
Non Conductive Standoff Box	TUV SUD Product Service	Non Conductive Standoff Box	4966	-	TU
Cable (18GHz)	Rosenberger	LU7-036-1000	5029	-	O/P Mon
Cable (18GHz)	Rosenberger	LU7-036-2000	5037	-	O/P Mon

TU – Traceability Unscheduled
O/P MON – Output Monitored with Calibrated Equipment

SECTION 4

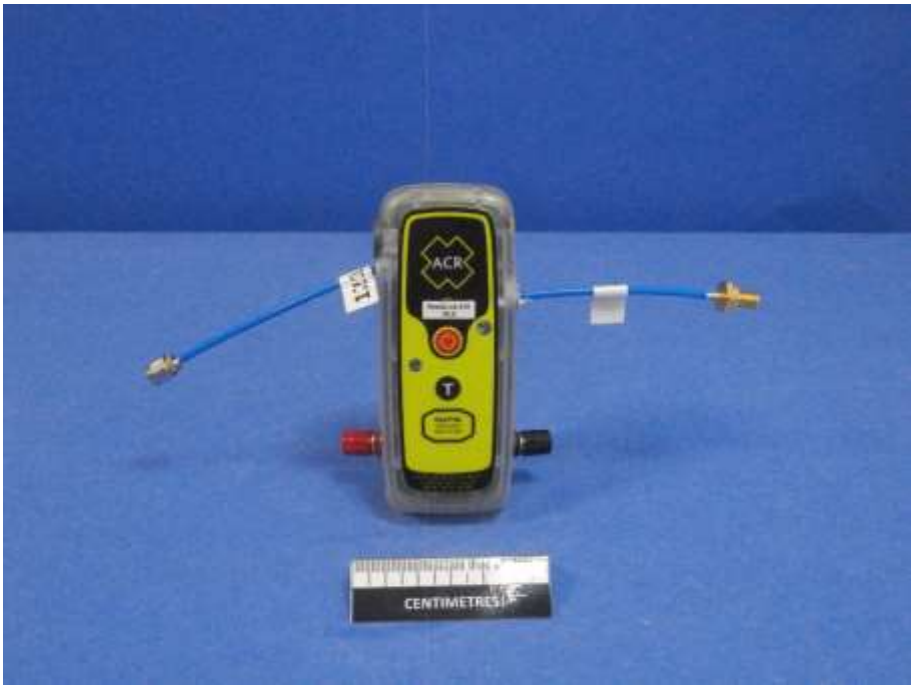
PHOTOGRAPHS

4.1 PHOTOGRAPHS OF EQUIPMENT UNDER TEST (EUT)

Front View

Rear View

Antenna Deployed



Modified Conducted Sample

Configuration 7 - A.3.8.2

Configuration 8 - Satellite Qualitative/A.3.8.2

SECTION 5

ACCREDITATION, DISCLAIMERS AND COPYRIGHT

5.1 ACCREDITATION, DISCLAIMERS AND COPYRIGHT

This report relates only to the actual item/items tested.

Our UKAS Accreditation does not cover opinions and interpretations and any expressed are outside the scope of our UKAS Accreditation.

Results of tests not covered by our UKAS Accreditation Schedule are marked NUA (Not UKAS Accredited).

ANNEX A

MANUFACTURER SUPPLIED INFORMATION

9/3/2020

ACR Electronics, Inc.
5757 Ravenswood Road
Fort Lauderdale, FL 33312-6645 USA

Report on:
Beacon Coding Software (BCS) and Position Data Encoding (PDE) of the ACR Electronics, Inc. PLB-400, PLB-425, PLB-410 and PLB-435

Document Number: **Y1-13-0399**

Revision: A.2

ACR Electronics, Inc.
5757 Ravenswood Road
Fort Lauderdale, FL 33312-6645 USA

REPORT ON Emergency Beacons Testing of the
ACR Electronics, Inc.
PLB-400, PLB-425, PLB-410 and PLB-435
Document Y1-13-0399 Revision A.2
9/3/2020

PREPARED AND APPROVED BY

Chris Westervelt, Senior Software Engineer
ACR Electronics, Inc., 5757 Ravenswood Road,
Fort Lauderdale, FL 33312, USA

DATED 9/3/2020

Table of Contents

SECTION 1

REPORT SUMMARY

**Emergency Beacons Testing of the
ACR Electronics, Inc.
PLB-400, PLB-425, PLB-410 and PLB-435**

1.1 INTRODUCTION

The information contained in this report is intended to show verification of the Emergency Beacon Testing of the ACR Electronics, Inc. PLB-400, PLB-425, PLB-410 and PLB-435 to the requirements of T.007 Issue 5 – Rev 3 Feb 2019, Beacon Coding Software (§ A.2.8) and Position Data Encoding (§ A.3.8.7)

Objective — To perform Emergency Beacon Testing to determine the Equipment Under Test's (EUT's) compliance with the Test Specification, for the series of tests carried out.

Specification	Cospas-Sarsat T.007 Issue 5 - Rev 3 Feb 2019
Manufacturer	ACR Electronics, Inc.
Beacon Model Number(s)	PLB-400, PLB-425, PLB-410 and PLB-435
Assembly Model Part Number and Version	PLB-400: A3-06-3138 -1, Rev D PLB-425: A3-06-3138, Rev D PLB-410: A3-06-3138 -3, Rev D PLB-435: A3-06-3138 -2 Rev D
Printed circuit board P/N and version	PLB-400: A3-07-0472-1 Rev D PLB-425: A3-07-0469-1 Rev F PLB-410: A3-07-0472-2 Rev D PLB-435: A3-07-0469-2 Rev F
Firmware Part Number and Version	K3-01-0145 Rev E
Beacon Serial Number(s)	PLB-425: 1 PLB-425: 2 PLB-435: 3
EUT Modification State	0
Number of Samples Tested	Three
Measurement Equipment	The major items of test equipment used for this test are identified below.
Environmental Conditions	Ambient Temperature 22 - 25°C Relative Humidity 40 - 50%
Deviations from standard test procedures	None
Non-compliances noticed	None
Start of Test	04/13/2019
Finish of Test	05/01/2019
Performed by	Chris Westervelt
Verified by	Bill Cox

1.2 BEACON MANUFACTURER AND BEACON MODEL

Beacon Manufacturer	ACR Electronics, Inc.
Beacon Model	PLB-400, PLB-425, PLB-410 and PLB-435
Other Model Names	For PLB-400: ResQLink 400 For PLB-425: ResQLink View For PLB-410: ResQLink 400 RLS For PLB-435: ResQLink View RLS

1.2.1 Information Provided by the Manufacturer

Name and Location of Beacon Test Facility: ACR Electronics, Inc.
5757 Ravenswood Road,
Fort Lauderdale, FL 33312

1.2.2 Applicable C/S Standards:

Document	Issue	Revision
C/S T.001	4	4
C/S T.007	5	3

1.3 REFERENCES

1.3.1 Documents

[1] Introduction to the COSPAS-SARSAT System, C/S G.003 (Issue 6 – Oct 2014)

[2] Specification for COSPAS-SARSAT 406 MHz Distress Beacons, C/S T.001 (Issue 4, Revision 4, Feb 2019)

[3] COSPAS-SARSAT 406 MHz Distress Beacon Type Approval Standard, C/S T.007 (Issue 5 - Revision 3, Feb 2019)

1.4 PRODUCT INFORMATION

1.4.1 Technical Description

The Equipment Under Test (EUT) was an ACR Electronics, Inc.:

- PLB-425, which is identical to PLB-400 in every way, with the exception of PLB-425 having the display connected.
- PLB-435, which is identical to PLB-410 in every way, with the exception of PLB-435 having the display connected. Further, PLB-410 and PLB-435, are respectively identical to PLB-400 and PLB-425 in every way, with the exception of PLB-410 and PLB-435 having RLS protocol enabled, and labeled.

1.4.2 Test Setup Procedure

For final testing, beacons should be configured such that the power output for both the 406 MHz signal and the 121.5 MHz signal are set for their final configuration.

Test results shall be recorded on ACR forms and/or the forms shown in C/S T.007 Annex F where indicated.

All measurements shall be performed with equipment and instrumentation which is in a known state of calibration.

Unless otherwise noted the FPR application software and the ACR Wand will be used for beacon communications including beacon serialization.

Figure 1: PLB-400 (left) and PLB-425 (right)

Figure 2: PLB-410 (left) and PLB-435 (right)

1.5 MODIFICATIONS

The table below details modifications, if any, made to the EUT during the test performed.

Modification State	Description of Modification	Modified By	Date Modification Fitted
0	None		

1.6 REPORT MODIFICATION RECORD

Revision A- First Issue on 9/3/2020.

SECTION 2

TEST DETAILS

**Emergency Beacons Testing of the
ACR Electronics, Inc.
PLB-400, PLB-425, PLB-410 and PLB-435**

TEST RESULTS TABLE

Parameters to be Measured	Range of Specification	Units	Test Results:	Comments
16. Beacon Coding Software				
Model: PLB-425, S/N: 1				
Sample message for each coding option of the applicable coding types	Correct	P / F	P	Test data in Section 2.1
Sample of self-test message for each coding option of the applicable coding types	Correct	P / F	P	Test data in Section 2.1
17. Navigation System				
Model PLB-425, S/Ns: 2				
Position Data Encoding	Correct	P / F	P	Test data in Section 2.2
18. RLS Location Protocol Procedure Additional Scripts				
Model PLB-435, S/Ns: 3				
Position Data Encoding	Correct	P / F	P	Test data in Section 2.3

2.1 BEACON CODING SOFTWARE

2.1.1 Equipment Under Test

PLB-425, Serial Number: 1

2.1.2 Date of Test and Modification State

Modification State 0 (PLB-425)

EUT system configuration during the test, including antenna, external ancillary devices, and modes of their operation.	The PLB-425 was configured as a conductive unit with 406 output going to an ACR FPR-300 to receive and decode the data.
Navigation device details	Input data from computer PC using NAVScript 1.23 and PC USB to 3.3v serial converter.

Test Start: April 15, 2019 08:20
Test End: May 01, 2019 17:30

Environmental Conditions: Ambient Temperature 22 - 25°C
Relative Humidity: 40 - 50%

2.1.3 TEST RESULTS

APPENDIX D TO ANNEX F BEACON CODING SOFTWARE RESULTS

ACR Electronics, Inc. PLB-400 and PLB-425

C/S T.007 Table F-D.2: Examples of Standard and National Location Protocol Beacon Messages

Protocol	Operational Message (in hexadecimal including bit and frame synchronisation bits)		Self-Test Message (in hexadecimal including bit and frame synchronisation bits)	GNSS Self Test Message (if applicable, in hexadecimal, including bit and frame synchronisation bits)
	Location "A"[1]	Location "B"[1]		Location "A"
	Lat: 26.051111° North Lon: 80.168889° West	Lat: 26.226667° North Lon: 80.188889° West		Lat: 26.051111° North Lon: 80.168889° West
Standard Location: EPIRB with MMSI	FFFE2F8C92F423F01A2 A0B81CCF78C44DA11	FFFE2F8C92F423F01A6A 0A615E370583A49B	FFFED08C92F423F07 FDFFB2BF037	FFFED08C92F423F01A2 A0B81CCF78C44DA11
Standard Location: EPIRB with Serial Number	FFFE2F8C96F9C0631A2 A0938D3F78C44DA11	FFFE2F8C96F9C0631A6A 08D841370583A49B	FFFED08C96F9C0637 FDFF992EF37	FFFED08C96F9C0631A2 A0938D3F78C44DA11
Standard Location: ELT with 24-bit Address	FFFE2F8C93AF0F0F1A2 A088356B78C44DA11	FFFE2F8C93AF0F0F1A6A 0963C4770583A49B	FFFED08C93AF0F0F7 FDFF8296A77	FFFED08C93AF0F0F1A2 A088356B78C44DA11
Standard Location: ELT with Serial Number	FFFE2F8C94F9C0631A2 A0D8811378C44DA11	FFFE2F8C94F9C0631A6A 0C6883F70583A49B	FFFED08C94F9C0637 FDFFD222DF7	FFFED08C94F9C0631A2 A0D8811378C44DA11
Standard Location: ELT with Aircraft Operator Designator	FFFE2F8C95C631F41A2 A09D7D3378C44DA11	FFFE2F8C95C631F41A6A 083741F70583A49B	FFFED08C95C631F47 FDFF97DEFF7	FFFED08C95C631F41A2 A09D7D3378C44DA11
Standard Location: PLB with Serial Number	FFFE2F8C97F9C0631A2 A0FBB8EF78C44DA11	FFFE2F8C97F9C0631A6A 0E5B1C370583A49B	FFFED08C97F9C0637 FDFFF11B237	FFFED08C97F9C0631A2 A0FBB8EF78C44DA11
National Location: EPIRB	FFFE2F8C9A704646855 028E149B71D080674	FFFE2F8C9A7046468F50 34981C770C2809C3	FFFED08C9A70465FC 0FF07A3F437	FFFED08C9A704646855 028E149B71D080674
National Location: ELT	FFFE2F8C98704646855 02C518B771D080674	FFFE2F8C987046468F50 3028DEB70C2809C3	FFFED08C9870465FC 0FF031336F7	FFFED08C98704646855 02C518B771D080674
National Location: PLB	FFFE2F8C9B704646855 02E6214B71D080674	FFFE2F8C9B7046468F50 321B41770C2809C3	FFFED08C9B70465FC 0FF0120A937	FFFED08C9B704646855 02E6214B71D080674

1 Location "A" and location "B" must be separated by at least 500 meters for the Standard, National and RLS location protocols.

2.1.4 TEST RESULTS

APPENDIX D TO ANNEX F BEACON CODING SOFTWARE RESULTS

ACR Electronics, Inc. PLB-410 and PLB-435

C/S T.007 Table F-D.2: Examples of Standard and National Location Protocol Beacon Messages

RLS Location: (ELT)	FFFE2F8C97F9C0631A2A0FBB8EF78C44DA11	FFFE2F8C97F9C0631A6A0E5B1C370583A49B	FFFED08C9D3E7018DFEFFAF3E438	FFFED08C97F9C0631A2A0FBB8EF78C44DA11
RLS Location: (EPIRB)	FFFE2F8C9D7E7018C69505796A78663A2946	FFFE2F8C9D7E7018C69505796A787B3B5784	FFFED08C9D7E7018DFEFFB533378	FFFED08C9D7E7018C69505796A78663A2946
RLS Location: (PLB)	FFFE2F8C9DBE7018C695079813B8663A2946	FFFE2F8C9DBE7018C695079813B87B3B5784	FFFED08C9DBE7018DFEFF9B24AB8	FFFED08C9DBE7018C695079813B8663A2946
RLS Location: Test	FFFE2F8C9DFE7018C6950638C4F8663A2946	FFFE2F8C9DFE7018C6950638C4F87B3B5784	FFFED08C9DFE7018DFEFF8129DF8	FFFED08C9DFE7018C6950638C4F8663A2946

2.2 NAVIGATION SYSTEM

2.2.1 Equipment Under Test

PLB-425, Serial Number: 2

2.2.2 Date of Test and Modification State

Modification State 0 (PLB-425)

EUT system configuration during the test, including antenna, external ancillary devices, and modes of their operation.	The PLB-425 was configured as a conductive unit with 406 output going to an ACR FPR-300 to receive and decode the data.
Navigation device details	Input data from computer PC using ACR Navscript tool and a PC serial port connected to the beacon GPS output node.

Test Start: April 15, 2019 08:20
Test End: April 29, 2019 17:30

Environmental Conditions: Ambient Temperature 22 - 25°C
Relative Humidity: 40 - 50%

APPENDIX C TO ANNEX F
NAVIGATION SYSTEM TEST RESULTS
ACR Electronics, Inc. PLB-400 and PLB-425, PUBX
C/S T.007 Table D.2: Position Data Encoding Results Standard Location Protocol

Script Reference (Table D.2 C/S T.007 - Issue 5 - Revision 3 February 2019)	Value of Encoded Location Bits Transmitted by Beacon	Confirmation that BCH is Correct ( )
1	Bits 65 - 85 = 0FFBFF Bits 113 - 132 = 83E0F	✓
2	Bits 65 - 85 = 100400 Bits 113 - 132 = 8420E Number of seconds after providing navigation data that beacon transmitted the above encoded location information: 49.00 seconds	✓
3	Bits 65 - 85 = 000000 Bits 113 - 132 = 8360D	✓
4	Bits 65 - 85 = 000ACF Bits 113 - 132 = 0F222	✓
5	Bits 65 - 85 = 0012CE Bits 113 - 132 = 93A60	✓
6	Bits 65 - 85 = 100ECF Bits 113 - 132 = 0FA10	✓
7	Bits 65 - 85 = 1B2964 Bits 113 - 132 = 80A00	✓
8	Bits 65 - 85 = 1B2D64 Bits 113 - 132 = 84E00	✓
9	Bits 65 - 85 = 0B46D0 Bits 113 - 132 = 03801	✓
10	Bits 65 - 85 = 0B42D0 Bits 113 - 132 = 08009	✓
11	Bits 65 - 85 = 14962A Bits 113 - 132 = 80200	✓
Self-Test Navigation Test Scripts		
12	Bits 65 - 85 = 0FFBFF Bits 113 - 132 = Bits are truncated.	✓
13	Bits 65 - 85 = 0FFBFF Bits 113 - 132 = Bits are truncated.	✓

ACR Electronics, Inc. PLB-400 and PLB-425, PUBX

Table D.3: Position Data Encoding Results National Location Protocol

Script Reference (Table D.2 C/S T.007 - Issue 5 - Revision 3 February 2019)	Value of Encoded Location Bits Transmitted by Beacon	Confirmation that BCH is Correct ( )
1	Bits 59 - 85 = 3F81FE0 Bits 113 - 126 = 27CF	*Pass*
2	Bits 59 - 85 = 4002000 Bits 113 - 126 = 284E Number of seconds after providing navigation data that beacon transmitted the above encoded location information: 48.00 seconds	*Pass*
3	Bits 59 - 85 = 0000000 Bits 113 - 126 = 26CD	*Pass*
4	Bits 59 - 85 = 0019678 Bits 113 - 126 = 060D	*Pass*
5	Bits 59 - 85 = 001567A Bits 113 - 126 = 2710	*Pass*
6	Bits 59 - 85 = 401B677 Bits 113 - 126 = 0740	*Pass*
7	Bits 59 - 85 = 6CA0B20 Bits 113 - 126 = 06C0	*Pass*
8	Bits 59 - 85 = 6CA2B20 Bits 113 - 126 = 21C0	*Pass*
9	Bits 59 - 85 = 2D03680 Bits 113 - 126 = 0701	*Pass*
10	Bits 59 - 85 = 2CF5680 Bits 113 - 126 = 2009	*Pass*
11	Bits 59 - 85 = 523F14F Bits 113 - 126 = 2040	*Pass*
Self-Test Navigation Test Scripts		
12	Bits 59 - 85 = 3F81FE0 Bits 113 - 126 = Bits are truncated.	*Pass*
13	Bits 59 - 85 = 3F81FE0 Bits 113 - 126 = Bits are truncated.	*Pass*

ACR Electronics, Inc. PLB-410/435
Table D.4: Position Data Encoding Results (RLS)

Script Reference (Table D.2 C/S T.007 - Issue 5 - Revision 3 February 2019)	Value of Encoded Location Bits Transmitted by Beacon	Confirmation that BCH is Correct ( )
1	Bits 67-85 = 3FDFF Bits 115-132 = 21F0F	*FCW*
2	Bits 67-85 = 40200 Bits 115-132 = 2210E Response time for beacon to transmit correct encoded location must be less than 62.5 sec. **Actual/Measured = 50.5 seconds**	*FCW*
3	Bits 67-85 = 00000 Bits 115-132 = 21B0D	*FCW*
4	Bits 67-85 = 00168 Bits 115-132 = 366CD	*FCW*
15	Bits 67-85 = 00966 Bits 115-132 = 35C90	*FCW*
6	Bits 67-85 = 40368 Bits 115-132 = 362E0	*FCW*
7	Bits 67-85 = 6CCB2 Bits 115-132 = 1DB00	*FCW*
8	Bits 67-85 = 6CEB2 Bits 115-132 = 1B900	*FCW*
9	Bits 67-85 = 2D368 Bits 115-132 = 01C01	*FCW*
10	Bits 67-85 = 2D168 Bits 115-132 = 04009	*FCW*
11	Bits 67-85 = 52715 Bits 115-132 = 20100	*FCW*
Self-Test Navigation Test Scripts		
12	Bits 67-85 = 3FDFF Bits 115-132 = truncated	*FCW*
13	Bits 67-85 = 3FDFF Bits 115-132 = truncated	*FCW*

2.3 RLS NAVIGATION SYSTEM TEST SCRIPTS

2.3.1 Equipment Under Test

PLB-435, Serial Number: 3

2.3.2 Date of Test and Modification State

Modification State 0 (PLB-435)

EUT system configuration during the test, including antenna, external ancillary devices, and modes of their operation.	The PLB-435 was configured as a conductive unit with 406 output going to an ACR FPR-300 to receive and decode the data.
Navigation device details	Input data from computer PC using ACR Navscript tool and a PC serial port connected to the beacon GPS output node.

Test Start: April 15, 2019 08:20
Test End: April 29, 2019 17:30

Environmental Conditions: Ambient Temperature 22 - 25°C
Relative Humidity: 40 - 50%

ANNEX D, NAVIGATION SYSTEM TEST SCRIPTS

ACR Electronics, Inc. PLB-410/435

Table D.5: RLS Location Protocol Procedure Additional Scripts

Script Reference (Table D.5 C/S T.007 - Issue 5 - Revision 3 February 2019)	RLS Location Protocol Procedure Additional Scripts	Confirmation that BCH is Correct ( )
1	S/B HEX_ID 193BFCE031BFDFF	✓
2	Transmitted 15 Hex ID is '193BFCE031BFDFF' Visual Indication of RLS request Bits 109-114 = 100001	✓
3	RLM Rec.15 Hex ID = 193BFCE031BFDFF, TYPE=1, & Valid UTC Visual indication within <5 seconds of RLM Receipt Bits 109-114 = 101001	✓
4	Transmitted 15 Hex ID is '193BFCE031BFDFF' Visual indication of RLS request sent Bits 109-114 = 100001	✓
5	RLM Rec.15 Hex ID = 193BFCE031BFDFF, TYPE=2, & Valid UTC Visual indication of RLS request sent for >5 minutes Bits 109-114 = 100001	✓
6	Transmitted 15 Hex ID is '193BFCE031BFDFF' Visual Indication of RLS request Bits 109 to 114 = 100001	✓
7	RLM Rec.15 Hex ID = 193BFCE032BFDFF, TYPE=1, & Valid UTC Visual indication of RLS request sent for >5 minutes Bits 109 to 114 = 100001	✓
8	Transmitted 15 Hex ID is '193BFCE031BFDFF' Visual Indication of RLS request Bits 109 to 114 = 100001	✓
9	RLM Rec.15 Hex ID = 193BFCE031BFDFE, TYPE=1, & Valid UTC Visual indication of RLS request sent for >5 minutes Bits 109 to 114 = 100001	✓
10	Transmitted 15 Hex ID is '193BFCE031BFDFF' Visual Indication of RLS request Bits 109 to 114 = 100001	✓
11	RLM Rec.15 Hex ID = 183BFCE031BFDFF, TYPE=1, & Valid UTC Visual indication of RLS request sent for >5 minutes Bits 109 to 114 = 100001	✓

2.4 TEST EQUIPMENT USED

	Description	ACR P/N
Hardware	PC-compatible	Purchased Commercial Hardware
Operating System	Windows XP SP3 / Windows 7	
Flash Device	STM32 ST-LINK Utility and ST-LINK / V2	Purchased Commercial Hardware
Software Verification and Validation Environment and Equipment	• PC	Purchased Commercial Hardware
	• Windows 10 / Windows 7	N/A
	• IAR	K1-02-0027
	• FPR300Logger 2.3 or greater	
	• USB Cable	A3-06-2599
	• FPR-300 ACR Electronics Field Programmer/Reader or other (406 message decoder)	A3-06-2619
	• FPR 2.0.15 and ACR Wand	K3-07-0033 and A3-06-3194
	• Power Supply	Purchased Commercial Hardware
	• NavScript 1.27 or higher	
	• PLB-X Configuration Tool 1.5.19 or higher	

Statements and Descriptions for

ACR PLB-410 AND PLB-435

COSPAS-SARSAT Application

Protection against Continuous Transmission for PLB-410 AND PLB-435 (Per C/S T.007 5. j. i.)

The protection against continuous transmission of the 406 MHz signal is provided through redundant controlling hardware and software.

Hardware:
PLB-410 AND PLB-435 is designed to limit any inadvertent 406MHz transmission:

The 406PLL_EN signal enable the IC U302 (406MHz synthesizer)The 406PLL_EN signal also supply voltage to the gate Q304 thru R323, and C336 with time constant 2.2sec if 406 Transmitter is on longer than 2.2sec sufficed voltage will developed on C336 to turn Q304 on this will result that U302 will be disabled and transmission will be terminated .

Software:
The 406 MHz RF Power module is controlled by single circuit/switch under microprocessor control. The transmission must cease if the microprocessor control line output is not high, putting out current at 3.3 volts. If the microprocessor should fail, the voltage on this line will go low and the transmission must stop. It is fail safe. The entire synthesizer/modulator circuitry is turned on and off for each transmission. Therefore, the transmission can never be continuous.

Additionally, after any system resets the control line to the 406 MHz RF Power Module is set low, terminating transmission. The software enables the microprocessor Watch-Dog Timer (WDT) Reset, so if the software were to execute object code blocking normal code execution, the WDT will reset the processor, terminating 406 MHz RF transmission.

Therefore, continuous transmission of the 406 MHz signal cannot occur.

Protection from Repetitive Self-Test Mode Transmissions (Per C/S T.007 5. j. iii.)

The Self-Test algorithm is in-line code with no loops that execute consecutive instructions initiating a self-test. It is possible to either; complete one self-test, one long GPS test, enter the ON state, enter the programming mode, or turn off. It is not possible to repeat the instructions. The self-test algorithm causes the software to continuously monitor the hardware during self-test. If the switch is left in self-test during and after the long GPS test is generated, the stuck mode is entered for a maximum of 10 minutes. This mode alternately flashes a red LED, the green LED. Nothing else can be generated when in this mode.

Confirmation that the Self-Test Messages Have Default Values at All Times (Per C/S T.007 5. j. iv.)

Initiation of a self-test will:

1. Initialize the 406 MHz message payload with inverted frame synchronization and default location data. No interleaving code execution will reset the frame synchronization or location data.

2. Start the self-test sequence, which will perform the 406 MHz burst shortly after self-test initialization.

3. Complete the self-test sequence.

Protection against Erroneous Position Encoding (Per C/S T.007 5. j. v.)

A GPS location fix is only considered valid if all of the following are acceptable: the header information ($PUBX), the quality indicator, the sentence checksum, number of satellites, HDOP and position data. Specifically, the predetermined header data must be verified, and the GPS Quality Indicator must meet the requirements; the number of satellites in-range must be greater than or equal to three and used the valid position fix with the lowest HDOP over 10 seconds. A location fix is only considered valid and encoded into a 406 MHz message if all of the above are valid. If not, the encoded location in the 406 MHz message is left as default location or, if the beacon has already been encoded with a valid location, the location has not changed. Therefore, ensuring a valid GPS position is used in each position update attempt.

Protection against Failure of the GPS Receiver
(Per C/S T.007 5. j. v.)

The GPS module has its own dedicated voltage regulator that has built in current limiter fold back circuit that operates as a short circuit protection and an output current limiter at the output of the voltage regulator. This protects the 406 side of the beacon from any hardware malfunctions with the GPS. Therefore, it is not possible for 406 MHz transmissions to be degraded by a malfunctioning GPS.

Protection Against Faulty Operation of the GPS Receiver
(Per C/S T.007 5. j. v.)

Any invalid data and/or hardware faults, between the output of the GPS receiver and the input to the beacon processor, will be ignored by the beacon firmware and the beacon will continue to operate as if there was no GPS data present.

GNSS Self-Test Mode
(Per C/S T.007 5. n.)

A GPS location fix is only considered valid if all of the following are acceptable: the header information ($PUBX), the quality indicator, the PUBX checksum, number of satellites and HDOP evaluation over 10 seconds.

GNSS Self-Test Mode

The GNSS self-test tests the internal GPS module. A GNSS self-test is initiated by pressing the Test button for greater than 5 seconds and less than 10 seconds. After 2 seconds the LED flashes blue. After 5 seconds the LED flashes blue quickly 3 times to indicate that the GNSS self-test has begun, if the number of allowed GNSS self-tests run has not been attained.

Pressing the Off button for 2 seconds will cause the beacon to turn off after during the GNSS self-test.

If the beacon enters the GNSS self-test the beacon will quickly flash green three (3) times.

During the GNSS self-test the internal GPS module is turned on and the beacon looks for good GNSS data using the internal GPS position. The GPS will remain on until a valid position fix has been obtained or until 110 seconds have elapsed. A typical GNSS self-test runs with a clear view of the sky takes approximately 45 seconds.

The complete GNSS self-test 406 MHz transmission is limited to one burst only of 520 milliseconds. The transmitted 406 message has an inverted frame synchronization pattern of 011010000. The position data fields in the transmitted 406 message contain the position data if a good fix was obtained otherwise the position data fields contain the default data.

If the beacon is able to acquire a valid GPS position before the 110 second time limit, the unit will transmit a test message with GNSS data as soon as a fix is established, self-test passes, and the beacon will flash the green LED for a ½ second at that time.

Once 20 GNSS self-tests have been completed, no further extended GNSS tests can take place until the battery is replaced and the internal counter is reset.

Upon completion of the GNSS self-test, the time it took to run the GNSS self-test is added to the total ON time and saved in nonvolatile memory even when there was no GPS data present.

Description of Artex PLB-410 and PLB-435 Modes of Operation 06-17-2019

Per C/S T.007 5(d)

Off/Standby Mode:

There is no activity and the unit is unpowered in this mode.

Self-Test Mode:

Self-test is initiated by pressing the Self-Test button for at least 2 seconds and not longer than 5 seconds. Beacon's ON time is checked. A blue light will flash followed by a 1/2 second green led flash indicating that 406MHz was transmitted, and another 1/2 second green led flash indicating that 121MHz was transmitted, followed by a long green light flash followed by a strobe light. This indicates a successful basic self-test. If a red LED flashes at the completion of the self-test, your beacon has failed. (The total time the beacon has been ON includes the time in self-test mode, GNSS self-test mode, and operating mode.)

The self-test takes approximately 14 seconds to run, 12 seconds to the LED report. The time is the same whether the beacon passes or fails.

Although the number of self-tests is not hard limited by the beacon design, the total ON time is checked as described above. If the total ON time exceeds 2 hr, the beacon will flash the Red LED twice at the completion of the self-test. Although the user is informed (user manual) to return the unit for service (battery replacement), additional self-tests are possible after the total ON time exceeds 2 hr.

During self-test the following occurs:

- One 406 MHz self-test message is transmitted with default location data
- The 406 MHz RF power is checked
- The nonvolatile memory is checked
- The 121.5 MHz signal is transmitted for < one second
- The 121.5 MHz RF power is checked
- The message received from the GPS module is checked to make sure it has the correct GPS header information

Upon completion of the self-test, the time it took to run the self-test is added to the total ON time counter and saved in nonvolatile memory.

GNSS Self-Test Mode:

The GNSS self-test is initiated by pressing the Self-Test button for at least 5 seconds and less than 10 seconds. After 2 seconds the LED flashes blue. After 5 seconds the LED flashes blue quickly 3 times to indicate that the GNSS self-test has begun. A continuous red flash will then occur every approximately every 5 seconds until GPS has been downloaded into the beacon. Once valid GPS data has been obtained, a long green flash will appear followed by a flash of the strobe light. This indicates a successful GPS self-test. This will take no longer than 110 seconds.

During the GNSS self-test, one 406 MHz GNSS self-test message is transmitted as soon as it received Valid data; it will be encoded with valid location data if available or with default location data and end of test if a GPS location was not found. A 1/2 second green flash will indicate that 406MHz has been transmitted with data and Red Flash if transmitted with default data.

The maximum number of GNSS self-tests is 20. The beacon keeps a count of how many GNSS self-tests have been run. If the count exceeds 20, the beacon does not allow additional GNSS self-tests to run. If additional GNSS self-tests are attempted, the beacon reverts to Off/Standby mode. The PLB-435 will also display low bat to show that this feature has been disabled.

The beacon also checks the total ON time at the beginning of a GNSS self-test. If the total ON time exceeds 2 hr the GNSS Test cannot be performed. The PLB-435 will display the GPS coordinates when a fix is acquired.

If the Self-Test button is accidentally held down throughout the GNSS self-test, the beacon will revert to Off/Standby Mode upon completion of the GNSS self-test; it will not run another self-test or GNSS self-test, and it will not enter the main operating mode.

Upon completion of the GNSS self-test, the time it took to run the GNSS self-test is added to the total ON time and saved in nonvolatile memory.

Programming Mode:

The programming mode can be entered by pressing the Self-Test button for min 15 seconds and max 20 seconds. After the self-test button has been held for 15 seconds, 5 blue flashes will indicate it is ok to release to enter the programming mode. The beacon can be programmed at the factory for specific country and protocol. This is not an end user function. If by chance the end user enters the Programming Mode, after 41 seconds from programming mode start, a message (in PLB-435) will show "Programming Failed" and the RED led will flash (PLB-410 and PLB-435). No changes to any factory programmed data, country and/or protocol will occur. PLB-410 and PLB-435 are limited to 10 attempts to enter programming mode. Any additional attempts are ignored with no warnings displayed on the screen or LEDs.

Main Operating Mode:

The main operating mode is entered by pressing the On/Off button for at least 2 seconds.

The Strobe flashes twice and red LED flashes once to indicate Activation. The LED then flashes red or green approximately every 5 seconds until the beacon is turned off or battery reaches end-of-life. Red LED flashes indicate that the unit has not received a valid fix or that 4 hours have passed without a valid GPS location update after GNSS acquisition; green LED flashes indicate that a valid GPS location has been acquired.

The white LED strobe and IR Strobe light flashes once approximately every 10 second until the beacon is turned off or battery end-of-life.

The first 406 MHz burst is transmitted within 50 seconds after the beacon is turned On. If a valid GPS location has been obtained before then, this location data is encoded in the transmitted message. If a valid GPS location has not been obtained, then the default location will be transmitted.

121.5 MHz transmissions begins 90 seconds after activation. The 121.5 MHz transmissions continue until 1 second before the next 406 MHz burst is due to begin. This cycle continues with 121.5 MHz transmissions ending 1 second before the next scheduled 406 MHz burst.

The time between 406 MHz bursts is determined by a random number generator and is between 47.6 seconds and 52.4 seconds.

The GPS turns on and off according to the schedule provided below. Location data is encoded into the 406 MHz message as soon as the received GPS location data has been validated as a good fix. GPS location data is validated as follows: the PUBX sentence header is checked to insure the sentence is parsed correctly, the basic PUBX sentence structure and checksum must be correct as per T.001, the number of satellites must be 3 or more, the quality factor must be Validated along with the best HDOP over 10 acquisitions, fix valid, and the latitude and longitude is used for the 406 message.

If 4 hours pass from the last valid GPS location update, the default location is encoded in the 406 MHz message.

The time the beacon is ON is periodically added to the total ON time and saved to the nonvolatile memory.

The beacon reverts to Off/Standby Mode if the On/Off button is held for longer than 2 seconds.

GPS On/Off Cycle:

The PLB410 and PLB435 beacons perform two overlaid GPS schedules. One is the standard Cospas-Sarsat schedule for non RLS beacons and the other is the RLS with m-offset schedule.

Cospas-Sarsat normal schedule: The internal navigation device makes an attempt every 15 minutes to obtain an initial location; until an initial location is obtained or 2 hours has passed after beacon activation. 1st Initial attempt is on for 11 minutes.
After an initial location is obtained or 2 hours has passed after beacon activation without obtaining an initial location, the navigation device attempts location updates according to the following regime:

- In the first 6 hours after beacon activation the navigation device attempts a location update every 30 minutes.
- Between 6 hours after beacon activation and until the end of the declared operating lifetime (depending on beacon type) a location update is attempted every 60 minutes.

Attempts at obtaining an initial location or location update the GNSS receiver is powered up for a period of at least 3 minutes and 35 seconds each time

Note: Figure 1 shows the GPS module ON schedule while attempting to obtain a valid GPS location.

If the GPS module acquired a valid GPS location before 2 hours have passed, the navigation device attempts location updates according to the following regime:
- In the first 6 hours after beacon activation the navigation device attempts a location update every 30 minutes. This schedule is followed regardless of beacon obtaining valid GPS location.
- Between 6 hours after beacon activation and until the end of the declared operating lifetime (depending on beacon type) a location update is attempted every 60 minutes. This schedule is followed regardless of beacon obtaining valid GPS location.

Cospas-Sarsat RLS schedule: Upon activation, the beacon's GPS will be on for the first 30 minutes. On each activation of the GPS, and attempt to acquire UTC from the appointed GNSS constellation will be attempted. After UTC is acquired and the first 30 minute on period is observed, the beacon will follow the m-offset schedule as defined by Cospas-Sarsat. For 30 seconds before m-offset and 15.5 minutes after m-offset, the GPS module will be active searching for an RLM message with a hex id equivalent to the beacons assigned hex id and will repeat for the calculated m-offset for the first 6 hours of activation each hour on the m-offset minute.

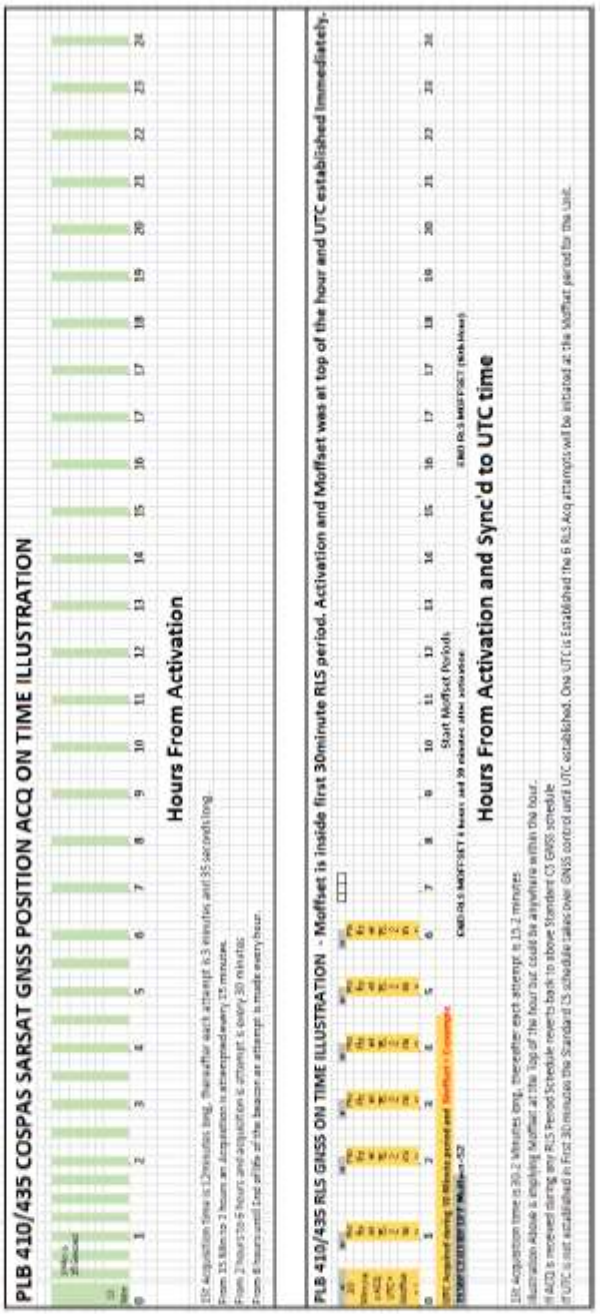
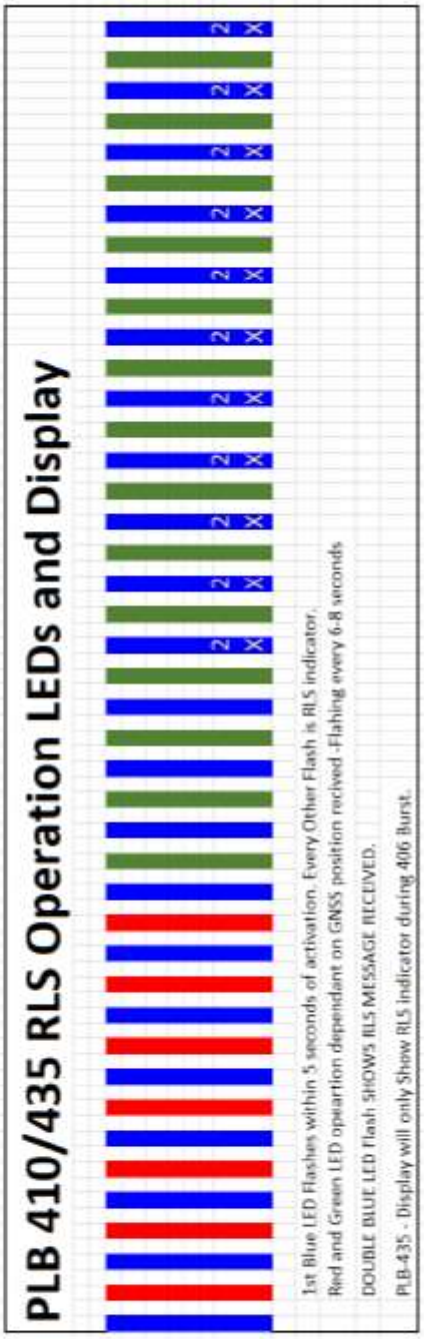


Figure 1: GPS ON times Schedule

RLS operation: After the first burst at 50 seconds after activation, the blue LED will blink between blinks of the red or green LED, to indicate the RLS request has been sent to SAR. If an acknowledgement with a matching hex id is received from the selected RLS provider GNSS system, the single flash blue LED will change to a double flash blue indicating that an acknowledgement to the RLS request has been received. The PLB435 will display RLS status every burst for the first hour and then every 5th burst thereafter. See Figure 2.



ANNEX B

RLM RECEPTION VERIFICATION

RLM Reception Verification

The Results provided in this annex are for information only, due to the live RLS satellite system being deactivated, A.3.8.8.2 (UTC Test) was performed using a GNSS Simulator.

Parameters to be Measured	Range of Specification	Units	Test Results	Comments
A.3.8.8.2 UTC Test - Config 8 Above Ground (with GNSS simulator)				
a) Visual Indication	≤ 5 seconds after activation	sec	1	
b) Transmitted Message Bits 109 to 114	100001	N/A	Pass	36 Hex message: **FFFE2F8C9DFE7018CC9014D3B1B8601E0A49**
c) GNSS Receiver turns on	≤ 5 seconds after first transmission	s	*	* GNSS receiver activates at beacon start up.
d) Time to output UTC	Record time since receiver activation	s	6	
e) GNSS Receiver position output Deny Beacon further GNSS signals	Valid Lat/Long No further receiver outputs	N/A N/A	Pass Pass	
f) Transmitted message valid location Message Bits 109 to 114	≤ 500m of actual beacon location 100001	m N/A	0.8 Pass	Actual Position: N 50° 0'0", W 1° 14'0" Encoded Position: N 50.0°, W -1.233° Position Error: 0.0238 km 36 Hex message: **FFFE2F8C9DFE7018CC9014D3B1B8601E0A49**
g) GNSS Receiver on time	≥ 30 minutes after beacon activation	min	33	
h) GNSS Receiver reactivation time	52 minutes +/- 5 seconds past next natural hour	min	Pass*	Reactivation Time: 11:51:29 * The Pass (with deviation to the standard) is awarded when considered alongside the ACR Electronics Document (Annex C)
i) GNSS Receiver on time	≥ 15 minutes after reactivation	min	16	
j) Transmitted message valid location Message Bits 109 to 114	≤ 500m of actual beacon location 100001	m N/A	4598 Pass	Actual Position: N 50° 0'0", W 1° 14'0" Encoded Position: N 49.959°, W -1.242° Position Error: 4.598 km 36 Hex message: **FFFE2F8C9DFE7018CC9014D3B1B844FE8D5D**
k) GNSS Receiver reactivation time	52 minutes +/- 5 seconds past next natural hour	min	Pass*	GNSS Reactivation at 12:51:29 * The Pass (with deviation to the standard) is awarded when considered alongside the ACR Electronics Document (Annex C)
m) GNSS Receiver on time	≥ 15 minutes after reactivation	min	N/A	15 min period does not apply as the RLM was received at 12:52:52 and beacon only accepts Type-1 RLM.
n) Time to indicate RLM receipt	≤ 15 minutes after receiver reactivation	min	Pass	1 min 23 sec after GNSS Reactivation
o) Transmitted Message Bits 109 to 114	101001	N/A	Pass	36 Hex message: **FFFE2F8C9DFE7018CC9014D3B1BA601E068D**

December 9, 2019

Cospas-Sarsat Secretariat,
1250 boulevard René-Lévesque West, Suite 4215, Montréal, Québec H3B 4W8 Canada

Attention: Reviewing Technical Officer

Subject: Deviation of T.007 A.3.8.8.1 (h) requirement.

Dear Technical Officer:

In Cospas-Sarsat 406 MHz Distress Beacons Type Approval Standard C/S T.007, Issue 5 – Revision 3 issued on February 2019, and specifically in Section A.8.8.1 (h) the requirement states:

"monitor the GNSS Receiver and ensure that it turns on at 52 minutes +/- 5 seconds after the next natural hour (e.g. if the beacon was first activated at 10:11 check to ensure that it turns on again at 11:52 +/- 5 seconds);"

Please note the specific wording "turns on at 52 minutes +/- 5 seconds" implies that turning on the GNSS receiver prior to this time, or maintaining it on past this time is not allowed. However, the manufacturer may turn the GNSS receiver on at any point prior to the time specified and maintain GNSS receiver past the 52 minutes + 5 seconds, and still satisfy the intent of this requirement.

ACR asserts that the wording "**turns** on at 52 minutes +/- 5 seconds" should be "~~turns~~ **is** on at 52 minutes +/- 5 seconds".

Please do not hesitate to contact me if you have any questions or if additional information is required.

Sincerely,

Dan Stankovic
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