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Report On

Emergency Beacons Testing of the
ACR Electronics Inc RLB-41
In accordance with Cospas-Sarsat T.007

Document 75927040 Report 01 Issue 1 **July 2015**

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REPORT ON

Emergency Beacons Testing of the
ACR Electronics Inc
RLB-41

Document 75927040 Report 01 Issue 1

July 2015

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DATED

15 July 2015

UKAS TESTING 0141

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SECTION 1

REPORT SUMMARY

Emergency Beacons Testing of the
ACR Electronics Inc
RLB-41

1.1 INTRODUCTION

The information contained in this report is intended to show verification of the Emergency Beacon Testing of the ACR Electronics Inc RLB-41 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)	RLB-41
Serial Number(s)	36 26
Number of Samples Tested	2
Test Specification/Issue/Date	Cospas-Sarsat T.007 Issue 4 - Rev 9 October 2014
Date of Receipt of Test Samples	9 March 2015
Order Number Date	31575 6 June 2014
Start of Test	13 March 2015
Finish of Test	29 May 2015
Name of Engineer(s)	M Hardy
Related Documents	Cospas-Sarsat T.001 Issue 3 Revision 15 October 2014 Cospas-Sarsat T.IP (TCXO) Issue 1 Revision 5 October 2013

1.2 APPLICATION FORM

Beacon Manufacturer and Beacon Model

Beacon Manufacturer	ACR Electronics, Inc.
Beacon Model	RLB-41
Other Model Names	GlobalFix ™ V4

Beacon Type and Operational Configurations

Beacon Type	**Beacon used while:**	**Tick where appropriate**
EPIRB	Floating in water or on deck or in a safety raft	X
PLB	On ground and above ground	
	On ground and above ground and floating in water	
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 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)		

Beacon Characteristics

Characteristic	Specification
Operating frequency	406.040 MHz 121.5 MHz
Operating temperature range	Tmin = -20 Tmax= +55
Temperature, at which minimum duration of continuous operation is expected	48 hours
Operating lifetime	INTERNAL
Beacon power supply type (internal non-rechargeable, internal re-chargeable, external, combined, other)	N/A
External power supply parameters (AC/DC and nominal voltages)	No
Is external power supply needed to energize the beacon or its ancillary devices in any of operation modes (N/A or Yes or No)	LiMnO2
Battery cell model name, size and number of cells in a battery pack, and details of the battery pack electrical configuration	CR-123A, 2/3A size, 3 battery packs, 3 cells each
Battery cell manufacturer	Panasonic
Battery pack manufacturer and part number	ACR pack.P/N: A3-06-2865 ACR cell.P/N: A1-13-0118 Panasonic cell P/N: CR-123A
Beacon manufacturers declared maximum allowed cell shelf- life (from date of cell manufacture to date of battery pack installation in the beacon)	0.25 years
Declared beacon battery replacement period (from date of installation in the beacon to expiry date marked on the beacon)	10 years
Oscillator type (e.g. OCXO, MCXO, TCXO)	TCXO
Oscillator manufacturer	RAKON Ltd (Made in New Zealand)
Oscillator model name /part number	RAKON P/N E5344LF, ACR P/N A1-11-0940
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 number	Antenna Assy RLB's, P/N A3-06-2554
Antenna cable assembly min/max RF- losses at 406 MHz, if applicable	N/A
Navigation device type (Internal, External or None)	Internal
Features in beacon that prevent degradation to 406 MHz signal or beacon lifetime resulting from a failure of navigation device or failure to acquire position data (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)	20_min to 4 hours
For Internal Navigation Devices	
- 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	GlobalTop Tech Inc.
- Navigation device model name and part Number	A1-11-0877-1
- Internal navigation device antenna type (integrated, internal, external, passive/active), manufacturer and model	Integrated in A1-11-0877-1
- GNSS system supported (e.g. GPS, GLONASS, Galileo)	GPS

For External Navigation Devices		
- 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.)	Refer to Operating Manual	Refer to Operating Manual
- The content of the encoded position data fields of the self-test message has default values	Yes	Yes,if NO GNSS found. No, if GNSS found.
- 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	No

- 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	NOTE 1	NOTE 1
- Self-test/ GNSS self-test 406 MHz burst duration (440 or 520 ms)	440 ms	520 ms
- Self-test message length format flag in bit 25, (“0” or “1”)	1	1
- Maximum duration of a self-test mode, sec	11 seconds	132 seconds
- Maximum recommended number of self-tests during battery pack replacement period	120	84
- 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	No
- Automatic termination of self-test mode immediately after completion of the self-test cycle (Yes or No)	Yes	Yes
- Maximum number of GNSS Self Tests (beacons with internal navigation devices only)	N/A	84
- GNSS Self-test results in transmission of a single burst, irrespectively of the test result (Yes or No)	N/A	Yes

- Maximum number of self-tests during battery pack replacement period	120	84
- Self-test/ GNSS self-test can be activated from beacon remote activation points (Yes & details or No)	N/A	N/A
- List all methods of Self-test mode and GNSS Self-test modes activation. Provide details on a separate sheet to describe	Switch at EPIRB Activated less than 2 s	Switch at EPIRB Activated more than 5 s

NOTE 1:

First pass/fail indication: Bring in line with T.001

- Beacon will check Battery Capacity monitor.
- Beacon will check for previous emergency activations.

Second pass/fail indication:

- Beacon will test that the PLL locks.
- Beacon will test that 406 MHz RF power is present during a 406 MHz transmission.
- Beacon will test battery voltage during a during a 406 MHz transmission.
- Beacon will test that 121.5 MHz RF power is present during a 121.5 MHz transmission.

Third pass/fail indication:

- Beacon will check the code checksum.
- Beacon will check the serialization of the current (ACR or POS) 406 message checksum.
- Beacon will check for GPS module communication.

Message Coding Protocols:	(x) Tick the boxes below against the intended protocol options	
User Protocol (tick where appropriate)		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 (tick where appropriate)	X	EPIRB with MMSI
	X	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 (tick where appropriate)	X	National Location: EPIRB
		National Location: ELT
		National Location: PLB
RLS Location Protocol (tick where appropriate)		EPIRB
		ELT
		PLB
User Location Protocol (tick where appropriate)	X	Maritime with MMSI
	X	Maritime with Radio Call Sign
	X	EPIRB Float Free with Serial Number
	X	EPIRB Non Float Free with Serial Number
	X	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

Beacon includes a homer transmitter(s) (Yes or No)	Yes
- homer transmitter(s) frequency	121.5MHz
- homer transmitter(s) power	17-22 dBm EIRP
- 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	>0.75 cd
- flash rate	20 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. Automatic activation occurs when water makes contact across water sensors
Beacon includes software or hardware features and functions not listed above and non-related to 406 MHz (Yes or No) List features and use a separate sheet if insufficient space	No

Beacon model hardware part number (P/N) and version	A3-06-2862, Rev B
Beacon model software/firmware P/N and version, date of issue/releases	K3-01-0122, Version B, Release 10/15/2014
Beacon model printed circuit board P/N and version	A3-07-0413 Rev G
Known non-compliances with C/S T.001 requirements (Yes or No)	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:.07/10/2015..... Signed: Dan Stankovic, Director of Certification and Test

Information Provided by the Cospas-Sarsat Accepted Test Facility

Name and Location of Beacon Test Facility: TUV SUD Product Service, Fareham, UK

Date of Submission for Testing: February 2015

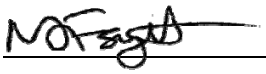
Applicable Test Standards:

Document	Issue	Revision	Date
C/S T.001	3	15	Oct 2014
C/S T.007	4	9	Oct 2014
IP (TCXO)	-	5	Oct 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, with the exception of the non-compliances indicated below.

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

Modulation (Section 2.2)
Antenna Characteristics (Section 2.10)

Signed: 

Name: Nic Forsyth

Position Held: Authorised Signatory

Date: 15 July 2015

1.3 PRODUCT INFORMATION

1.3.1 Technical Description

The Equipment Under Test (EUT) was an ACR Electronics Inc RLB-41 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 with the exception of Antenna Characteristics, Satellite Qualitative and Position Accuracy Time and Position Accuracy.

The RLB41 contains a TCXO oscillator. The Manufacturer has advised that the part number of this is (Rakon) E5344LF and the serial number of the sample which undertook the Temperature Gradient test was 1312.

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 Antenna Characteristics, Satellite Qualitative and Position Acquisition Time and Position Accuracy. The test configuration for these tests is a function of the beacon type and the operational environments supported by the beacon, as declared by the manufacturer.

System Configuration

The EUT was operated in 'Standalone' mode for all tests with the exception of battery current measurements. For this test the following additional configurations were included:

- EUT fitted in mounting bracket
- EUT fitted in Float Free Housing

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
- Depress Self-test activation button for 2 seconds
- List of items checked as per Customer Supplied Information (Application Form)

Long/GPS/GNSS Self-test
- Depress Self-test activation button for 6 seconds
- List of items checked as per Customer Supplied Information (Application Form)
- Navigation data applied as applicable (e.g. none applied for timeout, data applied for ‘fast acquisition’)

Operating
- Depress Main activation button
- 121 Homer active and offset
- GPS operating in normal duty cycle for the following navigation input conditions [Note1]
- No navigation data applied

Note 1: The manufacturer has declared that the GPS receiver operates as follows:

GPS On/Off Cycle:
The following schedule is followed until an initial valid GPS location is encoded into the beacon message:
- For the first 60 minutes, the GPS is turned on for 10 minutes once every 20 minutes.
- For the next 60 minutes, the GPS is turned on for 5 minutes once every 15 minutes.

If a valid location fix is obtained during either of the above GPS on times, the GPS is turned off immediately. The GPS is then turned on no less than 25 minutes and no more than 30 minutes from the time the GPS was previously turned on, then the GPS is then turned on and off according to the schedule below. If no valid fix was obtained during the above schedule, the schedule below is followed.

- For the next 6 hours the GPS is turned on once every 30 minutes and is on for a period of 5 minutes or until a valid location fix is obtained.
- For the next 18 hours the GPS is turned on once every 2 hours and is on for a period of 5 minutes or until a valid location fix is obtained.
- Until the battery end-of-life, the GPS is turned on once every 4 hours and is on for a period of 5 minutes or until a valid location fix is obtained.

The test interval for Electrical and Functional Tests at Constant Temperature (excluding Self-Test, GNSS Self-Test and Spurious emissions) was extended to 20 mins to ensure that measurements were made with the GPS receiver in both active and inactive modes. Spurious emissions measurements were made over a period of 22 hours in a combined measurement including Ambient, -20°C and +55°C.

1.4 MODIFICATIONS

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

1.5 REPORT MODIFICATION RECORD

Issue 1 – First Issue

SECTION 2

TEST DETAILS

Emergency Beacons Testing of the
ACR Electronics Inc
RLB-41

TEST RESULTS TABLE

Parameters to be Measured		Range of Specification	Units	Test Results			Comments
				Tmin	Tamb	Tmax	
				(-20°C)	(+21°C)	(+55°C)	
1. Power Output							**Result: Pass**
Model: RLB-41, S/N: #36, TUV Ref: TSR57 and Modification State 0							
Transmitter power output	(maximum)	35 - 39	dBm	38.78	38.54	38.34	
	(minimum)			38.76	38.53	38.33	
Power output rise time	(maximum)	< 5	ms	0.27	0.29	0.28	
	(minimum)			0.26	0.27	0.27	
Power output 1ms before burst	(maximum)	< -10	dBm	-36.14	-35.57	-36.21	
	(minimum)			-40.29	-39.98	-40.10	
2. Digital Message Coding							**Result: Pass**
Model: RLB-41, S/N: #36, TUV Ref: TSR57 and Modification State 0							
Bit Sync	1 - 15	15 bits “1”	P / F	P	P	P	
Frame sync	16 - 24	“000101111”	P / F	P	P	P	
Format flag	25	1 bit	bit value	1	1	1	
Protocol flag	26	1 bit	bit value	0	0	0	
Identification / position data	27 - 85	59 bits	P / F	P	P	P	
BCH code	86 -106	21 bits	P / F	P	P	P	
Emerg. Code/nat. use/supplem. Data	107 - 112	6 bits	bit value	110111	110111	110111	
Additional data / BCH (if applicable)	112 - 144	32 bits	P / F	P	P	P	
Position Error (if applicable)		< 5	km	n/a	n/a	n/a	

Parameters to be Measured	Range of Specification	Units	Test Results			Comments
			Tmin	Tamb	Tmax	
			(-20°C)	(+21°C)	(+55°C)	
3. Digital Message Generator						**Result: Pass**
Model: RLB-41, S/N: #36, TUV Ref: TSR57 and Modification State 0						
Repetition rate, T_R:						
Average T_R	$48.5 \le T_{Ravg} \le 51.5$	seconds	50.318	50.033	49.945	
Minimum T_R	$47.5 \le T_{Rmin} \le 48.0$	seconds	47.659	47.565	47.954	
Maximum T_R	$52.0 \le T_{Rmax} \le 52.5$	seconds	52.322	52.026	52.338	
Standard deviation	0.5 - 2.0	seconds	1.38	1.41	1.32	
Bit rate						
Minimum fb	≥ 396	bits/sec	399.91	399.91	399.91	
Maximum fb	≤ 404	bits/sec	399.93	399.93	399.93	
Total transmission time						
Short message (maximum)	435.6 - 444.4	ms	n/a	n/a	n/a	
Short message (minimum)			n/a	n/a	n/a	
Long message (maximum)	514.8 - 525.2	ms	520.03	520.04	520.04	
Long message (minimum)			519.99	520.00	520.00	
Unmodulated carrier						
Minimum T1	≥ 158.4	ms	160.00	160.00	160.00	
Maximum T1	≤ 161.6	ms	160.04	160.05	160.05	
First burst delay	≥ 47.5	seconds	50	50	50	

Parameters to be Measured		Range of Specification	Units	Test Results			Comments
				Tmin	Tamb	Tmax	
				(-20°C)	(+21°C)	(+55°C)	
4. Modulation							**Result: Non -compliance**
Model: RLB-41, S/N: #36, TUV Ref: TSR57 and Modification State 0							
Biphase-L		P / F	P / F	P	P	P	* Value within limits expanded by Test Facility Accuracy Limit as per T.008
Rise time	(maximum)	50 - 250	µs	215.3	206.4	198.4	
	(minimum)	50 - 250	µs	178.3	185.3	176.4	
Fall time	(maximum)	50 - 250	µs	215.6	204.6	195.6	
	(minimum)	50 - 250	µs	175.7	181.6	178.6	
Phase deviation: positive	(maximum)	+(1.0 to 1.2)	radians	1.1968	1.1760	1.2175*	
	(minimum)	+(1.0 to 1.2)	radians	0.9921*	1.0423	1.0085	
Phase deviation: negative	(maximum)	-(1.0 to 1.2)	radians	-1.2235*	-1.1677	-1.1943	
	(minimum)	-(1.0 to 1.2)	radians	-1.0188	-1.0316	-0.9906*	
Symmetry measurement		≤ 0.05		0.023	0.0214	0.0206	
5. 406 MHz Transmitted Frequency							**Result: Pass**
Model: RLB-41, S/N: #36, TUV Ref: TSR57 and Modification State 0							
Nominal Value	(maximum)	C/S T.001	MHz	406.0400174	406.0399983	406.0399796	
	(minimum)			406.0400172	406.0399982	406.0399790	
Short-term stability	(maximum)	≤ $2x10^{-9}$	/100ms	11.790E-11	95.148E-12	10.699E-11	
	(minimum)			10.600E-11	71.870E-12	97.297E-12	
Medium-term stability – Slope	(maximum)	(-1 to +1)$x10^{-9}$	/minutes	81.511E-13	10.983E-12	40.272E-11	
	(minimum)			-12.981E-11	-76.646E-12	20.971E-12	
Medium-term stability – Residual frequency variation	(maximum)	≤ $3x10^{-9}$		41.516E-11	28.132E-11	94.749E-11	
	(minimum)			25.364E-11	17.681E-11	37.340E-11	
6. Spurious Emissions into 50ohms							**Result: Pass**
Model: RLB-41, S/N: #36, TUV Ref: TSR57 and Modification State 0							
In band (406.0 – 406.1 MHz)		C/S T.001 mask	P / F	P			

Parameters to be Measured		Range of Specification	Units	Test Results			Comments
				Tmin	Tamb	Tmax	
				(-20°C)	(+21°C)	(+55°C)	
7. 406 MHz VSWR Check							**Result: Pass**
Model: RLB-41, S/N: #36, TUV Ref: TSR57 and Modification State 0							
Nominal transmitted frequency		C/S T.001	MHz	406.0400191	406.0399979	406.0399758	
Modulation rise time	(maximum)	50-250	µs	212.3	205.3	198.3	
	(minimum)	50-250	µs	178.3	184.3	180.3	
Modulation fall time	(maximum)	50-250	µs	211.6	201.6	195.7	
	(minimum)	50-250	µs	173.6	181.7	174.7	
Modulation phase deviation: positive	(maximum)	+ (1.0 to 1.2)	radians	1.1975	1.1747	1.2112	
	(minimum)	+ (1.0 to 1.2)	radians	1.0267	1.0384	1.0148	
Modulation phase deviation: negative	(maximum)	- (1.0 to 1.2)	radians	-1.1797	-1.1648	-1.1934	
	(minimum)	- (1.0 to 1.2)	radians	-1.0020	-1.0285	-1.0011	
Modulation symmetry measurement		≤ 0.05		0.0234	0.0214	0.0206	
Digital Message		correct	P / F	P	P	P	

Parameters to be Measured	Range of Specification	Units	Test Results			Comments
			Tmin	Tamb	Tmax	
			(-20°C)	(+21°C)	(+55°C)	
8(a). Self-test Mode						**Result: Pass**
Model: RLB-41, S/N: #36, TUV Ref: TSR57 and Modification State 0						
Frame sync	011010000	P / F	P	P	P	
Format flag	1 / 0	bit value	1	1	1	
Single radiated burst	≤440 / 520 (±1%)	ms	439.991	440.007	439.977	
Default position data (if applicable)	correct	P / F	F	P	P	
Description	provided	Y / N	Y			
Design data on protection against repetitive self-test mode transmissions	provided	Y / N	Y			Applicant's data: See Annex A
Single burst verification	one burst	P / F	P	P	P	
Provides for 15 Hex ID	correct	P / F	P	P	P	
121.5 MHz RF power (if applicable)	verify that RF power emitted	P / F	P	P	P	
406 MHz power	verify that RF power emitted	P / F	P	P	P	
Distinct indication of Self-Test	provided	Y / N	Y	Y	Y	On activation of the Self Test the following items are checked: Battery On Time RF Test Board Test.
Distinct indication of RF power being emitted	provided	Y / N	Y	Y	Y	Various LED indications are provided which correlate to the pass / fail status of the above parameter checks. In accordance with the Operator Manual, if the third LED indicator is green, 406 MHz and 121 MHz power has been emitted. See also Annex A for further detail.
Indication of Self-Test result	provided	Y / N	Y	Y	Y	
Maximum duration of Self-Test mode	≤ maximum duration of Self-Test	sec	10	10	10	
Automatic termination of Self-Test mode upon completion of Self-Test and indication of Self-Test results	verify automatic termination	Y / N	Y	Y	Y	

Parameters to be Measured	Range of Specification	Units	Test Results			Comments
			Tmin	Tamb	Tmax	
			(-20°C)	(+21°C)	(+55°C)	
8 (b). GNSS Self-Test Mode (if applicable)						**Result: Pass**
Model: RLB-41, S/N: #36, TUV Ref: TSR57 and Modification State 0						
Frame sync	011010000	P / F	P	P	P	
Format flag	1 / 0	bit value	1	1	1	
Single radiated burst	≤ 520 (+1%)	ms	520.039	520.040	520.046	
Position data (if applicable)	must be within 500m (or 5.25km for User Location Protocol) of the actual position	P / F	P	P	P	
Design data showing how GNSS Self-test is limited in number of transmissions and duration	provided	Y / N		-		Applicant's data: See Annex A
Single burst verification	one burst	P / F	P	P	P	
121.5 MHz RF power (if applicable)	GNSS self-test checks that RF power is emitted	Y / N		N		
406 MHz power	GNSS self-test checks that RF power is emitted	Y / N		Y		
Maximum duration of GNSS Self-test	-	s	132	132	132	Applicant's data: See Application Form
Actual duration of Self-test with encoded location	Less than maximum duration	s	43	45	49	
Maximum number of GNSS Self-tests (only beacons with internal navigation devices)	-	Number		84		Applicant's data: See Application Form
Distinct indication to register successful completion or failure of the GNSS self-test	must be provided	Y/N	Y	Y	Y	See comments in Test Results section
Distinct indication that a maximum number of GNSS self-tests has been attained after GNSS self-test mode activation and without transmission of a test message of further GNSS receiver current drain	must be provided	Y/N	Y	Y	Y	See comments in Test Results section

Parameters to be Measured	Range of Specification	Units	Test Results		Comments
9. Thermal Shock					**Result: Pass**
Model: RLB-41, S/N: #36, TUV Ref: TSR57 and Modification State 0					
Soak Temperature	30°C difference	°C	20		
Measurement Temperature		°C	-10		
Transmitted Frequency			Min	Max	
Nominal value	C/S T.001	MHz	406.0400212	406.0400237	
Short-term stability	≤ $2x10^{-9}$	/100ms	68.110E-12	13.265E-11	
Medium-term stability – Slope	(-2 to +2)$x10^{-9}$	/min	-27.589E-11	86.759E-12	
Medium-term stability – Residual frequency variation	≤ $3x10^{-9}$		16.823E-11	55.885E-11	
Transmitter power output	35 - 39	dBm	38.64	38.69	
Digital message	correct	P/F	P		
10. Operating Lifetime at Minimum Temperature					**Result: Pass**
Model: RLB-41, S/N: #36, TUV Ref: TSR57 and Modification State 0					
Pre-test battery discharge duration (operating) required		Hours	16.9		
Pre-test battery discharge duration (operating)		Hours	17		
Duration	>24	Hours	77.7 Hours at Tmin = -20°C		
Effective Operating Lifetime duration	>24	Hours	77.8 Hours at Tmin = -20°C		
Transmitted Frequency			Min	Max	Results are to 48 hours, and exclude the first 30 minutes.
Nominal value	C/S T.001	MHz	406.0400184	406.0400192	
Short-term stability	≤ $2x10^{-9}$	/100ms	4.94E-11	1.97E-10	
Medium-term stability – Slope	(-1 to +1)$x10^{-9}$	/min	-1.16E-10	1.06E-10	
Medium-term stability – Residual frequency variation	≤ $3x10^{-9}$		6.09E-11	5.17E-10	
Transmitter power output	35 - 39	dBm	38.65	38.83	
Digital message	correct	P/F	P		
Homer transmitter continuous operation during the lifetime test		hours	84.25		
			Start of Test	End of Test	
Homer frequency		MHz	121.499	121.499	
Homer peak power level		dBm	21.7	18.9	
Homer transmitter duty cycle		%	96.2	96.2	

Parameters to be Measured	Range of Specification	Units	Test Results				Comments
11. Temperature Gradient (5°C/hr)							**Result: Pass**
Model: RLB-41, S/N: #36, TUV Ref: TSR57 and Modification State 0 with TCXO Part Number: E5344LF. TCXO Serial Number: 1312 **(as advised by the Manufacturer)**							
Full Test							
Transmitted Frequency			Min		Max		
Nominal value	C/S T.007	MHz	406.0399691		406.0400234		
Short-term stability	≤ $2x10^{-9}$	/100ms	44.366E-12		17.567E-11		
Medium-term stability – Slope[1]	(-1 to +1)$x10^{-9}$	/min	-1.33E-10		3.13E-10		Data for points A to B, C+15 min to D and E+15 min to F
	(-2 to +2)$x10^{-9}$	/min	-5.26E-10		4.42E-10		Data for points B to C+15 min and D to E+15 min
Medium-term stability – Residual frequency variation	≤ $3x10^{-9}$		52.744E-12		89.345E-11		
Transmitter power output	35 – 39	dBm	38.44		38.82		
Digital message	correct	P/F	P				
12. Oscillator Aging							
Model: RLB-41, S/N: , TUV Ref: TSR and Modification State							
Data	provided	Y / N	Y				Applicant's data: See Annex A
13. Protection Against Continuous Transmission							
Model: RLB-41, S/N: , TUV Ref: TSR and Modification State							
Description	provided	Y / N	Y				Applicant's data: See Annex A
14. Satellite Qualitative Tests							**Result: Pass**
Model: RLB-41, S/N: 26, TUV Ref: TSR51 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	-	P	P	
Doppler Location results with error ≤ 5km	≥ 80	%	93.3	-	92.3	84.2	

Parameters to be Measured	Range of Specification	Units	Test Results				Comments
15. Antenna Characteristics							**Result: Non-Compliance (See Comment Below)**
Model: RLB-41, S/N: 26, TUV Ref: TSR51 and Modification State 0							
Test Configuration	As per C/S T.007		Configuration				
			1	2	3	4	
Polarisation	linear or RHCP		Linear	-	-	Linear	
VSWR	≤ 1.5		n/a	-	-	n/a	Detachable Antennas Only
$EIRP_{LOSS}$		dB	-0.11	-	-	-0.11	
$EIRP_{maxEOL}$	≤ 43	dBm	42.1	-	-	39.3	
$EIRP_{minEOL}$	≥ 32	dBm	32.5	-	-	29.7*	$EIRP_{minEOL}$ limit decreases to 30 dBm for Configuration 4 * Result within the allowance stated in section A.1 of T.007

Parameters to be Measured	Range of Specification	Units	Test Results			Comments
17. Navigation System						**Result: Pass**
Model: RLB-41, S/N: #36, TUV Ref: TSR57 and Modification State 0						
Location protocol	C/S T.001		National	Standard	User	
Position data default values	correct	P / F	P	P	P	
Configuration 5						
Position accuracy - A.3.8.2.1	C/S T.001	m	45.1	45.1	2012.5	
Position Acquisition Time - A.3.8.2.1	<10/1	min	0.83	0.83	0.83	
Position accuracy - A.3.8.2.2	C/S T.001	m	31.3	31.3	1553.3	
Position Acquisition Time - A.3.8.2.2	<10/1	min	0.83	0.83	0.83	
Configuration 7						
Position accuracy - A.3.8.2.1	C/S T.001	m	45.1	78.45	2012.5	
Position Acquisition Time - A.3.8.2.1	<10/1	min	0.83	0.83	0.83	
Position accuracy - A.3.8.2.2	C/S T.001	m	31.3	31.3	1553.3	
Position Acquisition Time - A.3.8.2.2	<10/1	min	0.83	0.83	0.83	
Configuration 8						
Position accuracy - A.3.8.2.1	C/S T.001	m	45.1	45.1	2012.5	
Position Acquisition Time - A.3.8.2.1	<10/1	min	0.83	0.83	0.83	
Position accuracy - A.3.8.2.2	C/S T.001	m	31.3	31.3	1553.3	
Position Acquisition Time - A.3.8.2.2	<10/1	min	0.83	0.83	0.83	
Encoded position data update interval	>20	min	29.5	29.33	30.25	
Position clearance after deactivation	cleared	P / F	P	P	P	
Position data input update interval (as applicable)	20/1	Min	n/a	n/a	n/a	
Position data encoding	correct	P / F	P	P	P	Applicant's data: See Annex A. Results checked against the requirements of Tables D1, D2 and D3 of T.007
Retained last valid position after navigation input lost	240(±5)	min	240.4	239.38	240.5	
Default position data transmitted after 240(±5) minutes without valid position data	cleared	P / F	P	P	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

Parameters to be Measured	Range of Specification	Units	Test Results	Comments
16. Beacon Coding Software				**Result: Pass**
Sample message for each coding option of the applicable coding types	correct	P / F	-	Applicant's data: See Annex A
Sample self-test message for each coding option of the applicable coding types	correct	P / F	-	Applicant's data: See Annex A

2.1 DIGITAL MESSAGE

2.1.1 Specification

Cospas-Sarsat T.007, Clause A.2.1 (b)

2.1.2 Equipment Under Test and Modification State

RLB-41 S/N: #36 - Modification State 0

2.1.3 Date of Test

18 March 2015 & 19 March 2015

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 22.3 - 23.6°C
Relative Humidity 32.1 - 35.0%

2.1.6 Test Results

Test Duration: 20 minutes
No. of bursts: 26

Ambient Temperature

Full 36 hex message	FFFE2F8C9EF9C0637FDFF83D15B783E0F66C

ITEM	BITS	VALUE
Message format: long format	25	1
Protocol: Location Protocol	26	0
Country code: 201 - **Albania**	27-36	0011001001
Type of location protocol: Standard Location - Test	37-40	1110
Test Protocol: Test Protocol (No Decode information in bits 41 to 64)	41-64	111110011100000001100011
Latitude Sign: default	65	0
Latitude Degrees: default	66-72	1111111
Latitude Minutes: default	73-74	11
Longitude Sign: default	75	0
Longitude Degrees: default	76-83	11111111
Longitude Minutes: default	84-85	11
BCH 1 Encoded:	86-106	00000111101000101011O
BCH 1 Calculated:	N/A	00000111101000101011O
Fixed bits (1101): Pass	107-110	1101
Position Data: Encoded Position Data Source From Internal Navigation Device	111	1
Aux Device: 121.5 MHz homer	112	1
Latitude Offset Sign: default	113	1
Latitude Offset Minutes: default	114-118	00000
Latitude Offset Seconds: default	119-122	1111
Longitude Offset Sign: default	123	1
Longitude Offset Minutes: default	124-128	00000
Longitude Offset Seconds: default	129-132	1111
BCH 2 Encoded:	133-144	011001101100
BCH 2 Calculated:	N/A	011001101100
Composite Latitude: default	N/A	Composite Longitude: default
15 Hex ID:	N/A	193DF380C6FFBFF

Product Service

Low Temperature

Full 36 hex message	FFFE2F8C9EF9C0637FDFF83D15B783E0F66C

ITEM	BITS	VALUE
Message format: long format	25	1
Protocol: Location Protocol	26	0
Country code: 201 - **Albania**	27-36	0011001001
Type of location protocol: Standard Location - Test	37-40	1110
Test Protocol: Test Protocol (No Decode information in bits 41 to 64)	41-64	111110011100000001100011
Latitude Sign: default	65	0
Latitude Degrees: default	66-72	1111111
Latitude Minutes: default	73-74	11
Longitude Sign: default	75	0
Longitude Degrees: default	76-83	11111111
Longitude Minutes: default	84-85	11
BCH 1 Encoded:	86-106	00000111101000101010
BCH 1 Calculated:	N/A	00000111101000101010
Fixed bits (1101): Pass	107-110	1101
Position Data: Encoded Position Data Source From Internal Navigation Device	111	1
Aux Device: 121.5 MHz homer	112	1
Latitude Offset Sign: default	113	1
Latitude Offset Minutes: default	114-118	00000
Latitude Offset Seconds: default	119-122	1111
Longitude Offset Sign: default	123	1
Longitude Offset Minutes: default	124-128	00000
Longitude Offset Seconds: default	129-132	1111
BCH 2 Encoded:	133-144	011001101100
BCH 2 Calculated:	N/A	011001101100
Composite Latitude: default	N/A	Composite Longitude: default
15 Hex ID:	N/A	193DF380C6FFBFF

Product Service

High Temperature

Full 36 hex message	FFFE2F8C9EF9C0637FDFF83D15B783E0F66C

ITEM	BITS	VALUE
Message format: long format	25	1
Protocol: Location Protocol	26	0
Country code: 201 - **Albania**	27-36	0011001001
Type of location protocol: Standard Location - Test	37-40	1110
Test Protocol: Test Protocol (No Decode information in bits 41 to 64)	41-64	111110011100000001100011
Latitude Sign: default	65	0
Latitude Degrees: default	66-72	1111111
Latitude Minutes: default	73-74	11
Longitude Sign: default	75	0
Longitude Degrees: default	76-83	11111111
Longitude Minutes: default	84-85	11
BCH 1 Encoded:	86-106	00000111101000101010
BCH 1 Calculated:	N/A	00000111101000101010
Fixed bits (1101): Pass	107-110	1101
Position Data: Encoded Position Data Source From Internal Navigation Device	111	1
Aux Device: 121.5 MHz homer	112	1
Latitude Offset Sign: default	113	1
Latitude Offset Minutes: default	114-118	00000
Latitude Offset Seconds: default	119-122	1111
Longitude Offset Sign: default	123	1
Longitude Offset Minutes: default	124-128	00000
Longitude Offset Seconds: default	129-132	1111
BCH 2 Encoded:	133-144	011001101100
BCH 2 Calculated:	N/A	011001101100
Composite Latitude: default	N/A	Composite Longitude: default
15 Hex ID:	N/A	193DF380C6FFBFF

2.2 MODULATION

2.2.1 Specification

Cospas-Sarsat T.007, Clause A.2.1 (d)

2.2.2 Equipment Under Test and Modification State

RLB-41 S/N: #36 - Modification State 0

2.2.3 Date of Test

18 March 2015 & 19 March 2015

2.2.4 Test Equipment Used

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

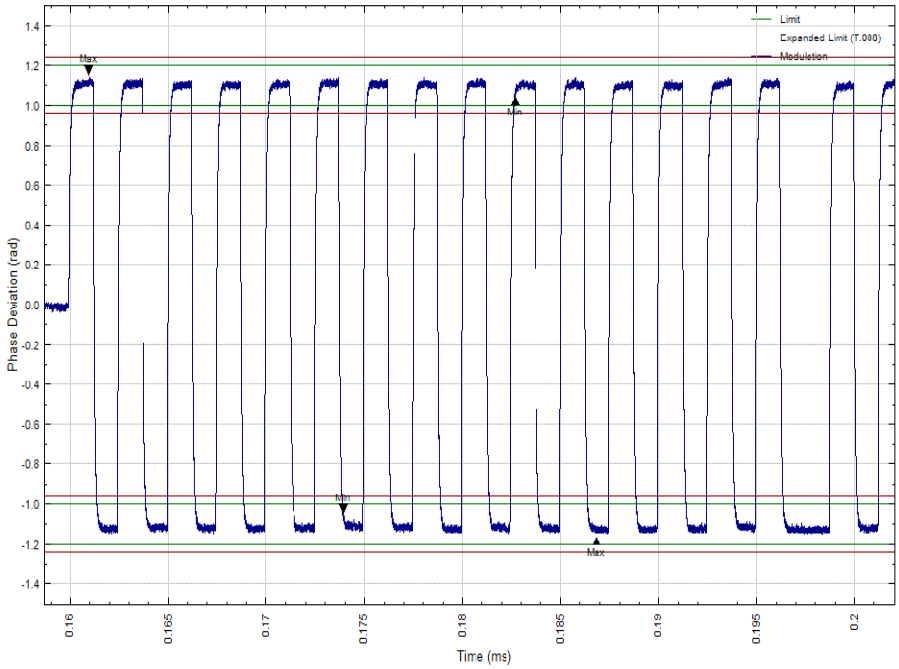
2.2.5 Environmental Conditions

Ambient Temperature 22.3 - 23.6°C
Relative Humidity 32.1 - 35.0%

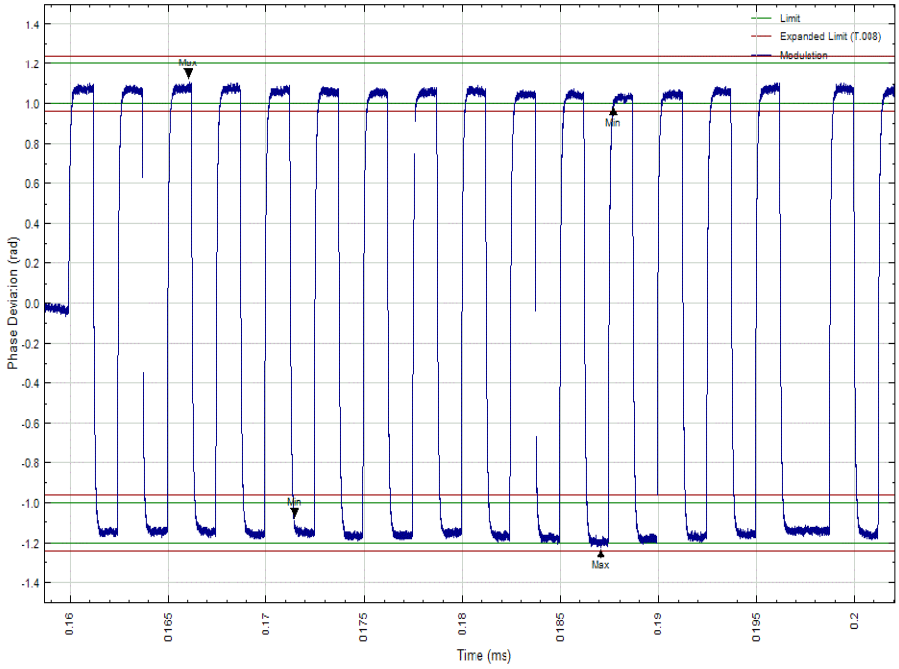
2.2.6 Test Results

Test Duration: 20 minutes
No. of bursts: 26

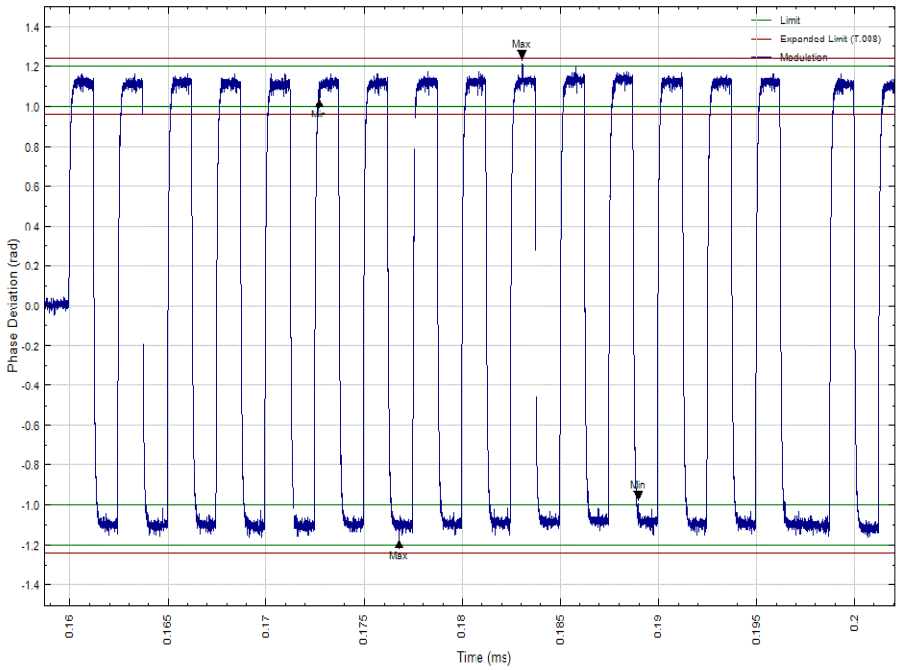
Ambient Temperature



Low Temperature



High Temperature



2.3 SPURIOUS EMISSION INTO 50 OHMS

2.3.1 Specification

Cospas-Sarsat T.007, Clause A.2.1 (f)

2.3.2 Equipment Under Test and Modification State

RLB-41 S/N: #36 - Modification State 0

2.3.3 Date of Test

18 & 19 March 2015

2.3.4 Test Equipment Used

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

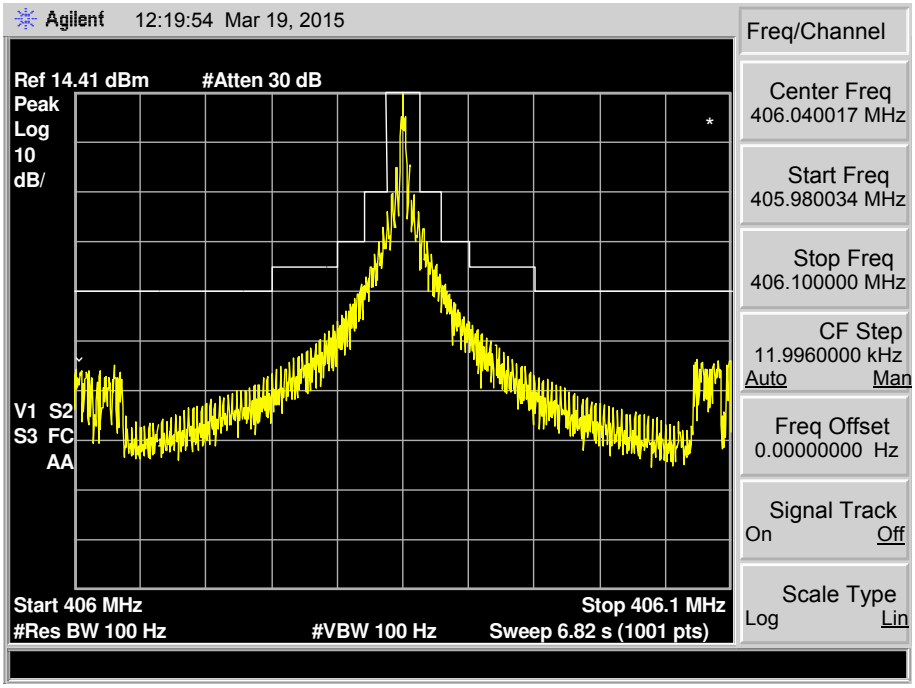
2.3.5 Environmental Conditions

Ambient Temperature 22.6°C
Relative Humidity 30.8%

2.3.6 Test Results

Test Duration: 22 Hours

Combined Ambient, Low and High Temperature



2.4 406 MHZ VSWR CHECK

2.4.1 Specification

Cospas-Sarsat T.007, Clause A.2.1 (g)

2.4.2 Equipment Under Test and Modification State

RLB-41 S/N: #36 - Modification State 0

2.4.3 Date of Test

18 March 2015 & 19 March 2015

2.4.4 Test Equipment Used

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

2.4.5 Environmental Conditions

Ambient Temperature 22.3 - 23.6°C
Relative Humidity 32.1 - 35.0%

2.4.6 Test Results

Test Duration: 20 minutes
No. of bursts: 26

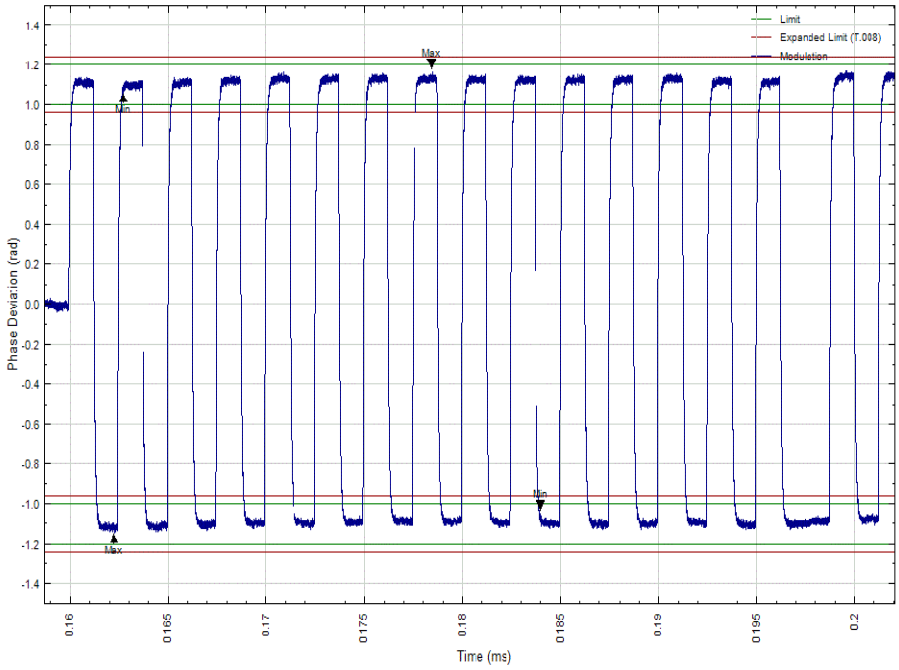
Ambient Temperature

Full 36 hex message	FFFE2F8C9EF9C0637FDFF83D15B783E0F66C

ITEM	BITS	VALUE
Message format: long format	25	1
Protocol: Location Protocol	26	0
Country code: 201 - **Albania**	27-36	0011001001
Type of location protocol: Standard Location - Test	37-40	1110
Test Protocol: Test Protocol (No Decode information in bits 41 to 64)	41-64	111110011100000001100011
Latitude Sign: default	65	0
Latitude Degrees: default	66-72	1111111
Latitude Minutes: default	73-74	11
Longitude Sign: default	75	0
Longitude Degrees: default	76-83	11111111
Longitude Minutes: default	84-85	11
BCH 1 Encoded:	86-106	00000111010001010110
BCH 1 Calculated:	N/A	00000111010001010110
Fixed bits (1101): Pass	107-110	1101
Position Data: Encoded Position Data Source From Internal Navigation Device	111	1
Aux Device: 121.5 MHz homer	112	1
Latitude Offset Sign: default	113	1
Latitude Offset Minutes: default	114-118	00000
Latitude Offset Seconds: default	119-122	1111
Longitude Offset Sign: default	123	1
Longitude Offset Minutes: default	124-128	00000
Longitude Offset Seconds: default	129-132	1111
BCH 2 Encoded:	133-144	011001101100
BCH 2 Calculated:	N/A	011001101100
Composite Latitude: default	N/A	Composite Longitude: default
15 Hex ID:	N/A	193DF380C6FFBFF

Product Service

Modulation Plot



Product Service

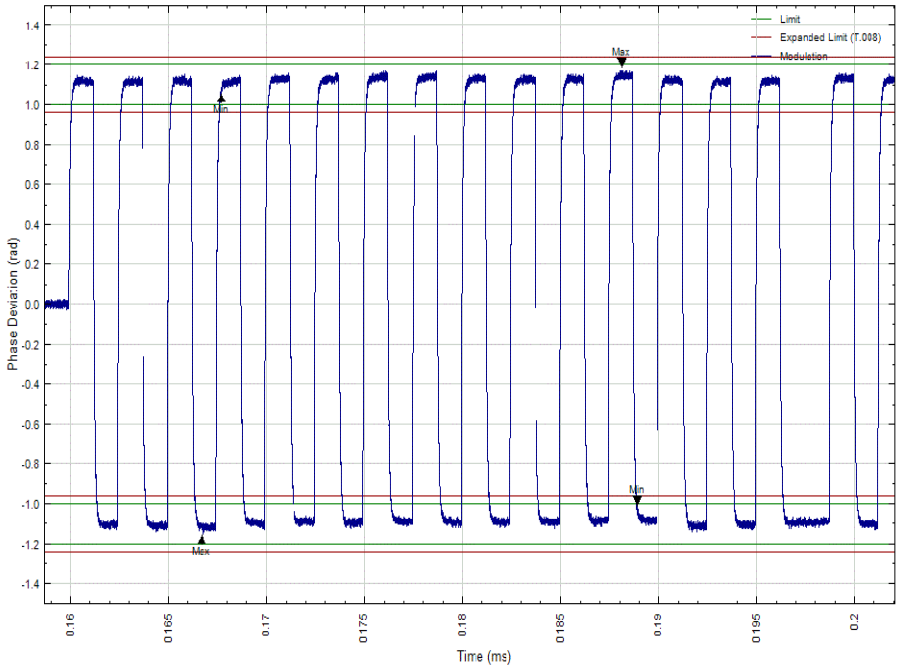
Low Temperature

Full 36 hex message	FFFE2F8C9EF9C0637FDFF83D15B783E0F66C

ITEM	BITS	VALUE
Message format: long format	25	1
Protocol: Location Protocol	26	0
Country code: 201 - **Albania**	27-36	0011001001
Type of location protocol: Standard Location - Test	37-40	1110
Test Protocol: Test Protocol (No Decode information in bits 41 to 64)	41-64	11111001110000000110011
Latitude Sign: default	65	0
Latitude Degrees: default	66-72	1111111
Latitude Minutes: default	73-74	11
Longitude Sign: default	75	0
Longitude Degrees: default	76-83	11111111
Longitude Minutes: default	84-85	11
BCH 1 Encoded:	86-106	00000111101000101011O
BCH 1 Calculated:	N/A	00000111101000101011O
Fixed bits (1101): Pass	107-110	1101
Position Data: Encoded Position Data Source From Internal Navigation Device	111	1
Aux Device: 121.5 MHz homer	112	1
Latitude Offset Sign: default	113	1
Latitude Offset Minutes: default	114-118	00000
Latitude Offset Seconds: default	119-122	1111
Longitude Offset Sign: default	123	1
Longitude Offset Minutes: default	124-128	00000
Longitude Offset Seconds: default	129-132	1111
BCH 2 Encoded:	133-144	011001101100
BCH 2 Calculated:	N/A	011001101100
Composite Latitude: default	N/A	Composite Longitude: default
15 Hex ID:	N/A	193DF380C6FFBFF

Product Service

Modulation Plot

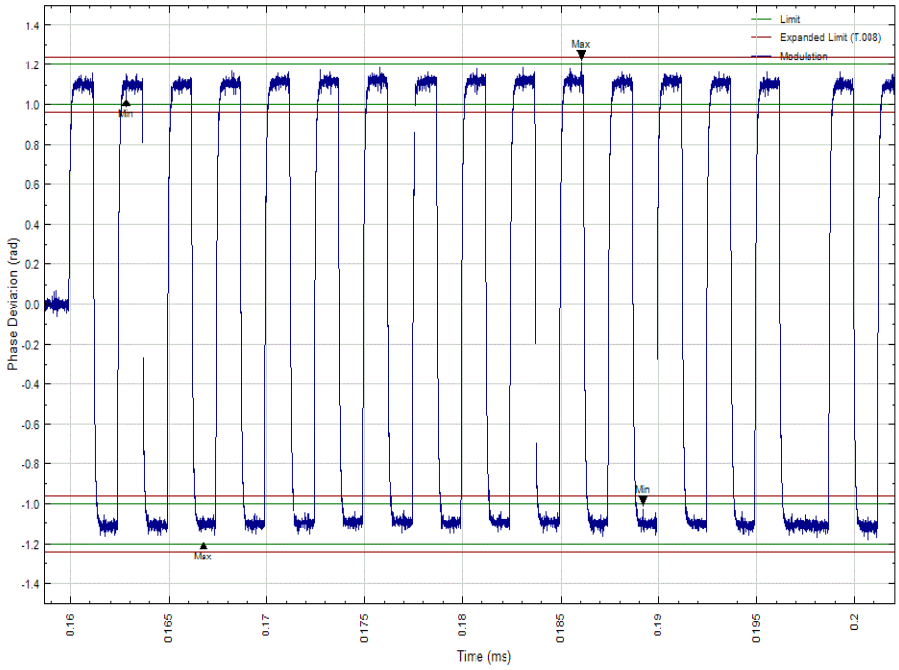


High Temperature

Full 36 hex message	FFFE2F8C9EF9C0637FDFF83D15B783E0F66C

ITEM	BITS	VALUE
Message format: long format	25	1
Protocol: Location Protocol	26	0
Country code: 201 - **Albania**	27-36	0011001001
Type of location protocol: Standard Location - Test	37-40	1110
Test Protocol: Test Protocol (No Decode information in bits 41 to 64)	41-64	111110011100000001100011
Latitude Sign: default	65	0
Latitude Degrees: default	66-72	1111111
Latitude Minutes: default	73-74	11
Longitude Sign: default	75	0
Longitude Degrees: default	76-83	11111111
Longitude Minutes: default	84-85	11
BCH 1 Encoded:	86-106	00000111010001010110
BCH 1 Calculated:	N/A	00000111010001010110
Fixed bits (1101): Pass	107-110	1101
Position Data: Encoded Position Data Source From Internal Navigation Device	111	1
Aux Device: 121.5 MHz homer	112	1
Latitude Offset Sign: default	113	1
Latitude Offset Minutes: default	114-118	00000
Latitude Offset Seconds: default	119-122	1111
Longitude Offset Sign: default	123	1
Longitude Offset Minutes: default	124-128	00000
Longitude Offset Seconds: default	129-132	1111
BCH 2 Encoded:	133-144	011001101100
BCH 2 Calculated:	N/A	011001101100
Composite Latitude: default	N/A	Composite Longitude: default
15 Hex ID:	N/A	193DF380C6FFBFF

Modulation Plot



2.5 SELF-TEST MODES

2.5.1 Specification

Cospas-Sarsat T.007, Clause A.2.1 (h)

2.5.2 Equipment Under Test and Modification State

RLB-41 S/N: #36 - Modification State 0

2.5.3 Date of Test

18 March 2015, 19 March 2015 & 20 March 2015

2.5.4 Test Equipment Used

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

2.5.5 Environmental Conditions

Ambient Temperature 22.8 - 23.6°C
Relative Humidity 30.5 - 35.0%

2.5.6 Test Results

Self-test Mode

Ambient Temperature

Full 36 hex message	FFFED08C9EF9C0637FDFF83D15B7

ITEM	BITS	VALUE
Message format: long format	25	1
Protocol: Location Protocol	26	0
Country code: 201 - **Albania**	27-36	0011001001
Type of location protocol: Standard Location - Test	37-40	1110
Test Protocol: Test Protocol (No Decode information in bits 41 to 64)	41-64	111110011100000001100011
Latitude Sign: default	65	0
Latitude Degrees: default	66-72	1111111
Latitude Minutes: default	73-74	11
Longitude Sign: default	75	0
Longitude Degrees: default	76-83	11111111
Longitude Minutes: default	84-85	11
BCH 1 Encoded:	86-106	00000111010001010110
BCH 1 Calculated:	N/A	00000111010001010110
Fixed bits (1101): Pass	107-110	1101
Position Data: Encoded Position Data Source From Internal Navigation Device	111	1
Aux Device: 121.5 MHz homer	112	1
Composite Latitude: default	N/A	Composite Longitude: default
15 Hex ID:	N/A	193DF380C6FFBFF

Note: Self-test at ambient temperature was carried out with navigation data applied.

Product Service

Low Temperature

Full 36 hex message	FFFED08C9EF9C0637FDFF83D15B7

ITEM	BITS	VALUE
Message format: long format	25	1
Protocol: Location Protocol	26	0
Country code: 201 - **Albania**	27-36	0011001001
Type of location protocol: Standard Location - Test	37-40	1110
Test Protocol: Test Protocol (No Decode information in bits 41 to 64)	41-64	111110011100000001100011
Latitude Sign: default	65	0
Latitude Degrees: default	66-72	1111111
Latitude Minutes: default	73-74	11
Longitude Sign: default	75	0
Longitude Degrees: default	76-83	11111111
Longitude Minutes: default	84-85	11
BCH 1 Encoded:	86-106	00000111101000101010
BCH 1 Calculated:	N/A	00000111101000101010
Fixed bits (1101): Pass	107-110	1101
Position Data: Encoded Position Data Source From Internal Navigation Device	111	1
Aux Device: 121.5 MHz homer	112	1
Composite Latitude: default	N/A	Composite Longitude: default
15 Hex ID:	N/A	193DF380C6FFBFF

High Temperature

Full 36 hex message	FFFED08C9EF9C0637FDFF83D15B7

ITEM	BITS	VALUE
Message format: long format	25	1
Protocol: Location Protocol	26	0
Country code: 201 - **Albania**	27-36	0011001001
Type of location protocol: Standard Location - Test	37-40	1110
Test Protocol: Test Protocol (No Decode information in bits 41 to 64)	41-64	111110011100000001100011
Latitude Sign: default	65	0
Latitude Degrees: default	66-72	1111111
Latitude Minutes: default	73-74	11
Longitude Sign: default	75	0
Longitude Degrees: default	76-83	11111111
Longitude Minutes: default	84-85	11
BCH 1 Encoded:	86-106	00000111101000101010
BCH 1 Calculated:	N/A	00000111101000101010
Fixed bits (1101): Pass	107-110	1101
Position Data: Encoded Position Data Source From Internal Navigation Device	111	1
Aux Device: 121.5 MHz homer	112	1
Composite Latitude: default	N/A	Composite Longitude: default
15 Hex ID:	N/A	193DF380C6FFBFF

GNSS Self-test mode

GNSS self-test with valid position	Actual	Declared
Count	84	84
Maximum Duration (s)	131	132
Indication of GNSS ST activation/completion	• A GNSS self-test activation is activated by holding the TEST button for 6 seconds, and confirmed by three green LED flashes. A red LED will flash periodically until the test is complete. • If navigation data is detected, a single audible tone and green LED flash will indicate the end of the test with position data. • If no navigation data is detected a red LED flash and audible tone will indicate the end of the test with default position data.	
Indication of counter limit reached	Audible Tone and three red LED flashes will indicate that no further tests are available.	

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

With Valid Navigation Input

	Standard Location Protocol		
	-20 °C	+22 °C	+55 °C
Frame sync verification	011010000	011010000	011010000
Format Flag (1 bit)	1	1	1
Single Radiated burst (ms)	519.991	520.019	520.046
Position data	P	P	P
Single burst verification	P	P	P
Actual duration (sec)	33	45	37
Position Input Latitude	N 51° 22'35"		
Position Input Longitude	W 1° 49'50"		
Position Output Latitude*	N 51°22'36"	N 51°22'36"	N 51°22'36"
Position Output Longitude*	W 1°49'52"	W 1°49'52"	W 1°49'52"
Position Error (m)	49.3	49.3	49.3

	National Location Protocol		
	-20 °C	+22 °C	+55 °C
Frame sync verification	011010000	011010000	011010000
Format Flag (1 bit)	1	1	1
Single Radiated burst (ms)	520.039	520.039	520.023
Position data	P	P	P
Single burst verification	P	P	P
Actual duration (sec)	43	43	46
Position Input Latitude	N 51° 22'35"		
Position Input Longitude	W 1° 49'50"		
Position Output Latitude*	N 51°22'36"	N 51°22'36"	N 51°22'36"
Position Output Longitude*	W 1°49'48"	W 1°49'52"	W 1°49'52"
Position Error (m)	49.3	49.3	49.3

	User Location Protocol		
	-20 °C	+22 °C	+55 °C
Frame sync verification	011010000	011010000	011010000
Format Flag (1 bit)	1	1	1
Single Radiated burst (ms)	520.009	520.040	520.019
Position data	P	P	P
Single burst verification	P	P	P
Actual duration (sec)	35	37	49
Position Input Latitude	N 51° 22'35"		
Position Input Longitude	W 1° 49'50"		
Position Output Latitude*	N 51°24'00"	N 51°24'00"	N 51°24'00"
Position Output Longitude*	W 1°48'00"	W 1°48'00"	W 1°48'00"
Position Error (m)	3372.6	3372.6	3372.6

Without Valid Navigation Input

	Standard Location Protocol		
	-20 °C	+22 °C	+55 °C
Frame sync verification	011010000	011010000	011010000
Format Flag (1 bit)	1	1	1
Single Radiated burst (ms)	519.992	520.012	520.023
Default Position data	P	P	P
Single burst verification	P	P	P
Actual duration (sec)*	131	131	131

	National Location Protocol		
	-20 °C	+22 °C	+55 °C
Frame sync verification	011010000	011010000	011010000
Format Flag (1 bit)	1	1	1
Single Radiated burst (ms)	519.995	520.006	520.015
Default Position data	P	P	P
Single burst verification	P	P	P
Actual duration (sec)*	131	131	131

	User Location Protocol		
	-20 °C	+22 °C	+55 °C
Frame sync verification	011010000	011010000	011010000
Format Flag (1 bit)	1	1	1
Single Radiated burst (ms)	520.018	520.013	520.011
Default Position data	P	P	P
Single burst verification	P	P	P
Actual duration (sec)*	131	131	131

All duration measurements were taken from the time the Test switch was activated, to when all apparent activity appeared to cease.

2.6 THERMAL SHOCK

2.6.1 Specification

Cospas-Sarsat T.007, Clause A.2.2

2.6.2 Equipment Under Test and Modification State

RLB-41 S/N: #36 - Modification State 0

2.6.3 Date of Test

23 March 2015

2.6.4 Test Equipment Used

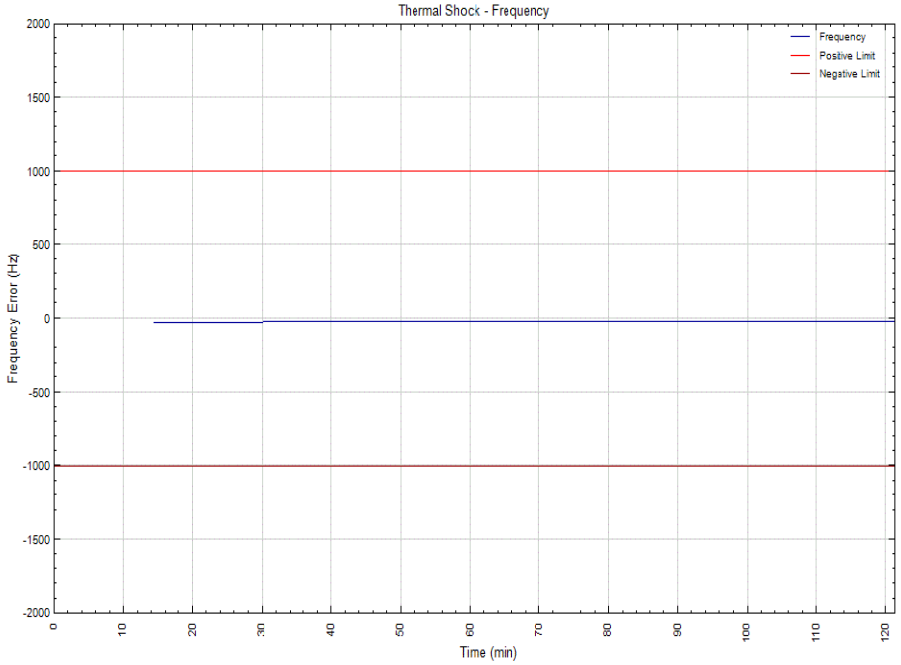
The major items of test equipment used for the above tests are identified in Section 3.1.

2.6.5 Environmental Conditions

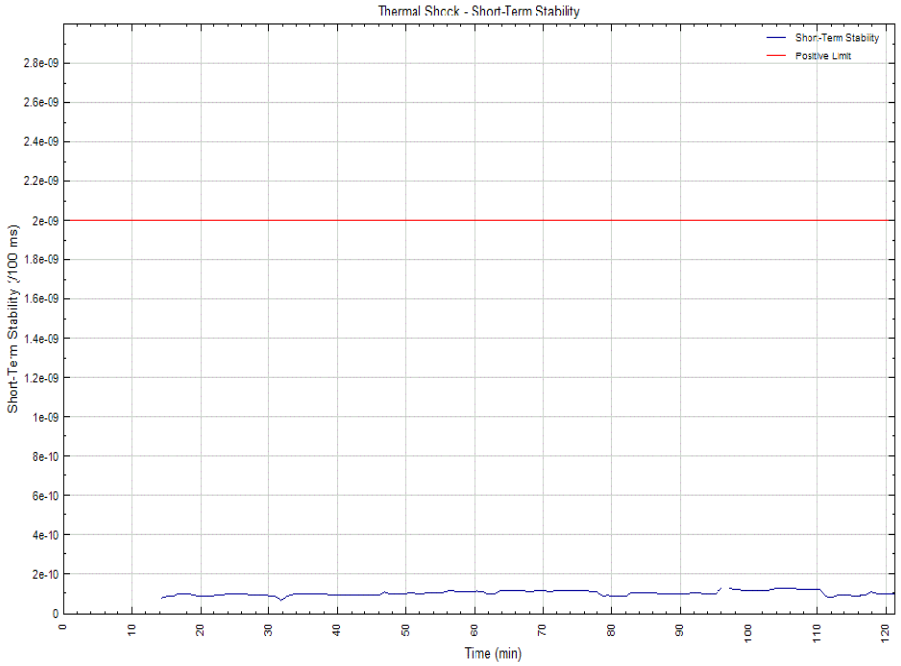
Ambient Temperature 23.5°C
Relative Humidity 29.1%

2.6.6 Test Results

Nominal Frequency

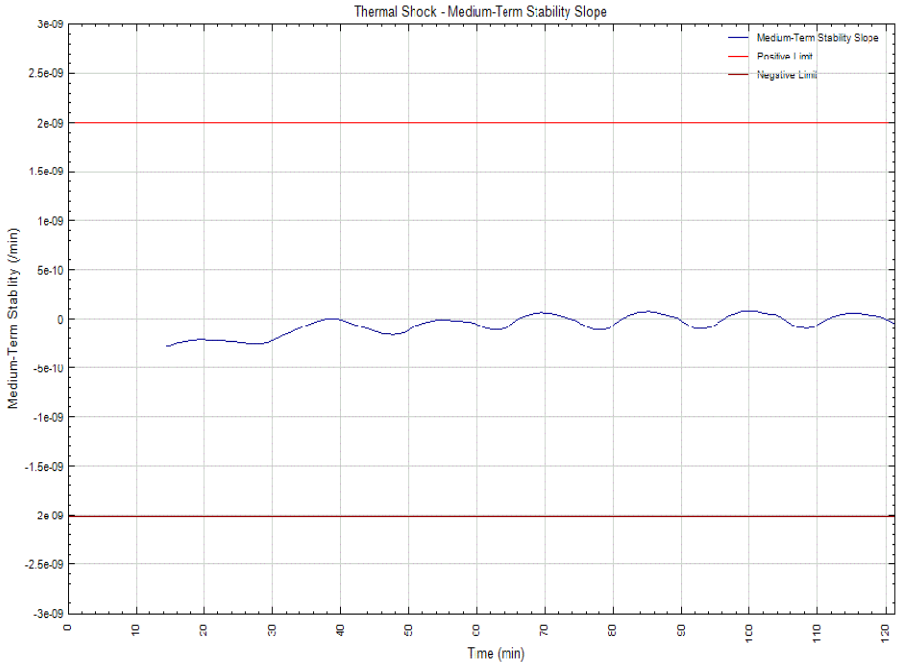


Short Term Stability

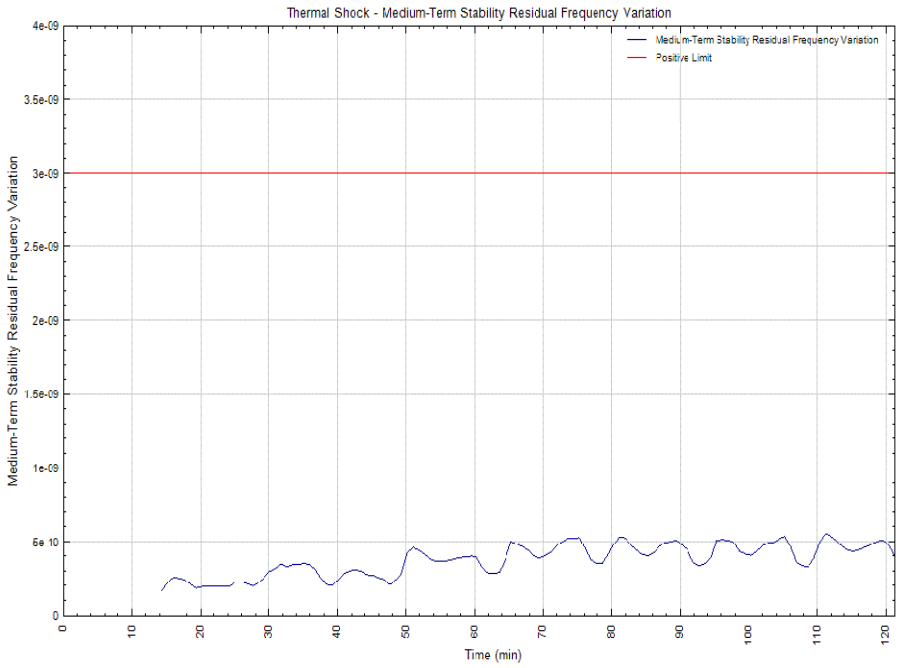


Product Service

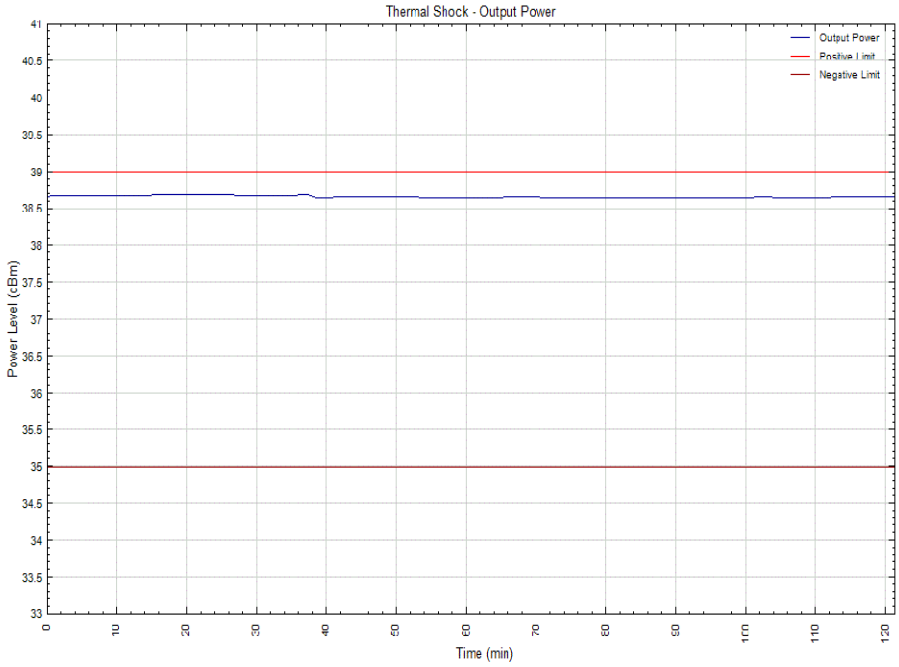
Medium Term Stability, Mean Slope



Medium Term Stability, Residual Frequency Variation



Output Power



Product Service

Digital Message

Full 36 hex message	FFFE2F8C9EF9C0637FDFF83D15B783E0F66C

ITEM	BITS	VALUE
Message format: long format	25	1
Protocol: Location Protocol	26	0
Country code: 201 - **Albania**	27-36	0011001001
Type of location protocol: Standard Location - Test	37-40	1110
Test Protocol: Test Protocol (No Decode information in bits 41 to 64)	41-64	111110011100000001100011
Latitude Sign: default	65	0
Latitude Degrees: default	66-72	1111111
Latitude Minutes: default	73-74	11
Longitude Sign: default	75	0
Longitude Degrees: default	76-83	11111111
Longitude Minutes: default	84-85	11
BCH 1 Encoded:	86-106	00000111101000101011O
BCH 1 Calculated:	N/A	00000111101000101011O
Fixed bits (1101): Pass	107-110	1101
Position Data: Encoded Position Data Source From Internal Navigation Device	111	1
Aux Device: 121.5 MHz homer	112	1
Latitude Offset Sign: default	113	1
Latitude Offset Minutes: default	114-118	00000
Latitude Offset Seconds: default	119-122	1111
Longitude Offset Sign: default	123	1
Longitude Offset Minutes: default	124-128	00000
Longitude Offset Seconds: default	129-132	1111
BCH 2 Encoded:	133-144	011001101100
BCH 2 Calculated:	N/A	011001101100
Composite Latitude: default	N/A	Composite Longitude: default
15 Hex ID:	N/A	193DF380C6FFBFF

2.7 OPERATING LIFETIME AT MINIMUM TEMPERATURE

2.7.1 Specification

Cospas-Sarsat T.007, Clause A.2.3

2.7.2 Equipment Under Test and Modification State

RLB-41 S/N: #36 - Modification State 0

2.7.3 Date of Test

24 March 2015 & 25 March 2015

2.7.4 Test Equipment Used

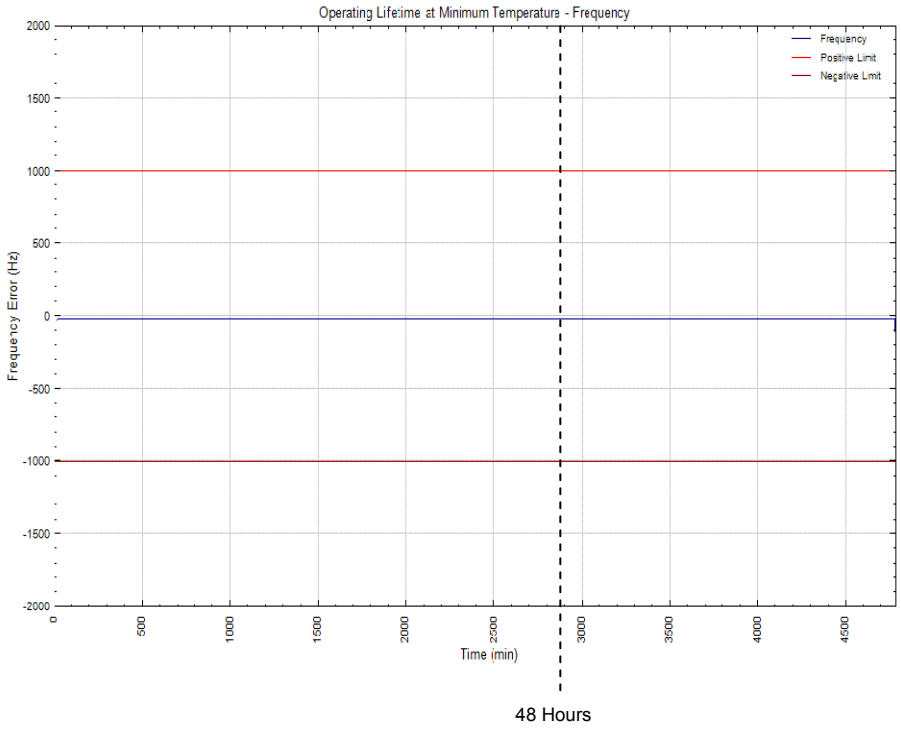
The major items of test equipment used for the above tests are identified in Section 3.1.

2.7.5 Environmental Conditions

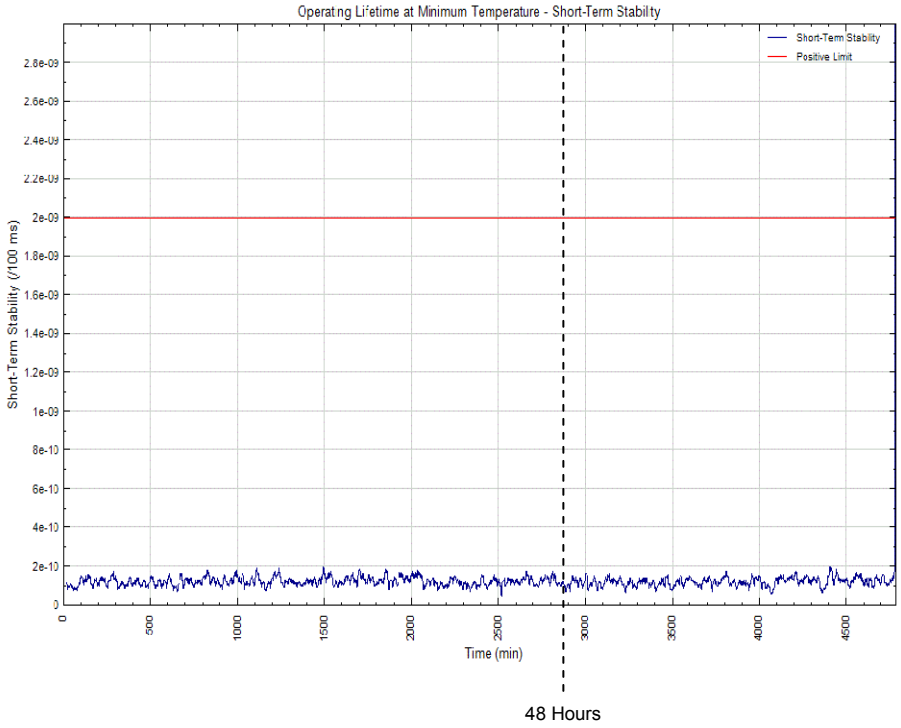
Ambient Temperature 22.6°C
Relative Humidity 27.0 - 45.9%

2.7.6 Test Results

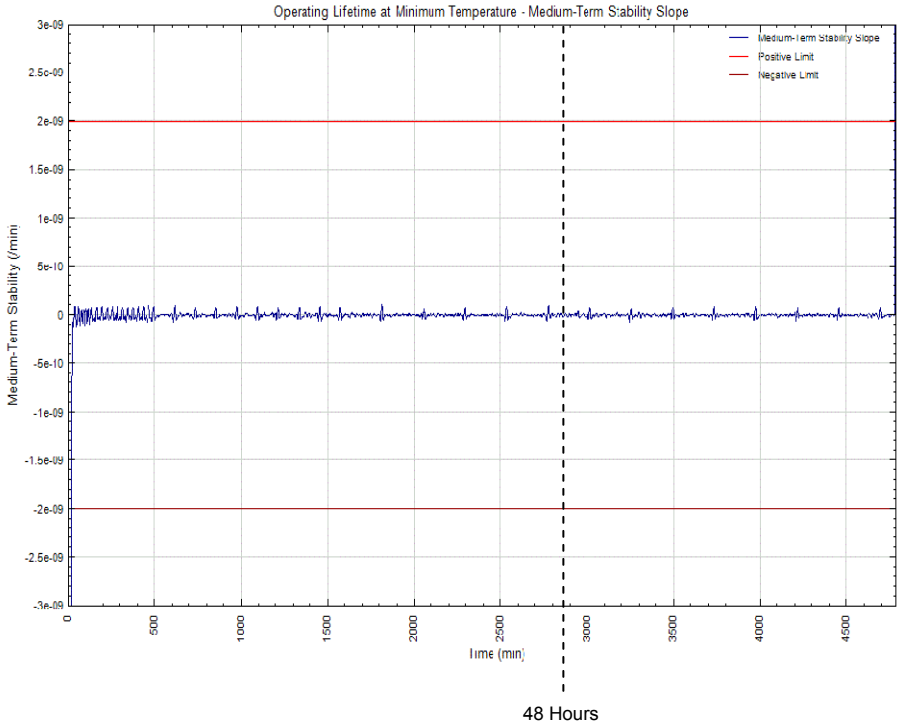
Nominal Frequency



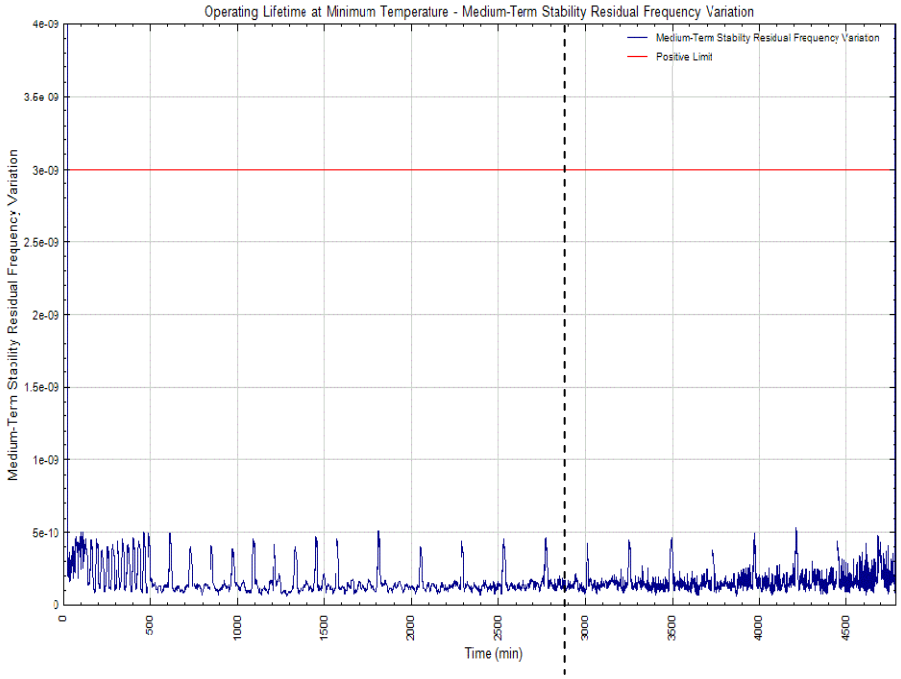
Short Term Stability



Medium Term Stability, Mean Slope

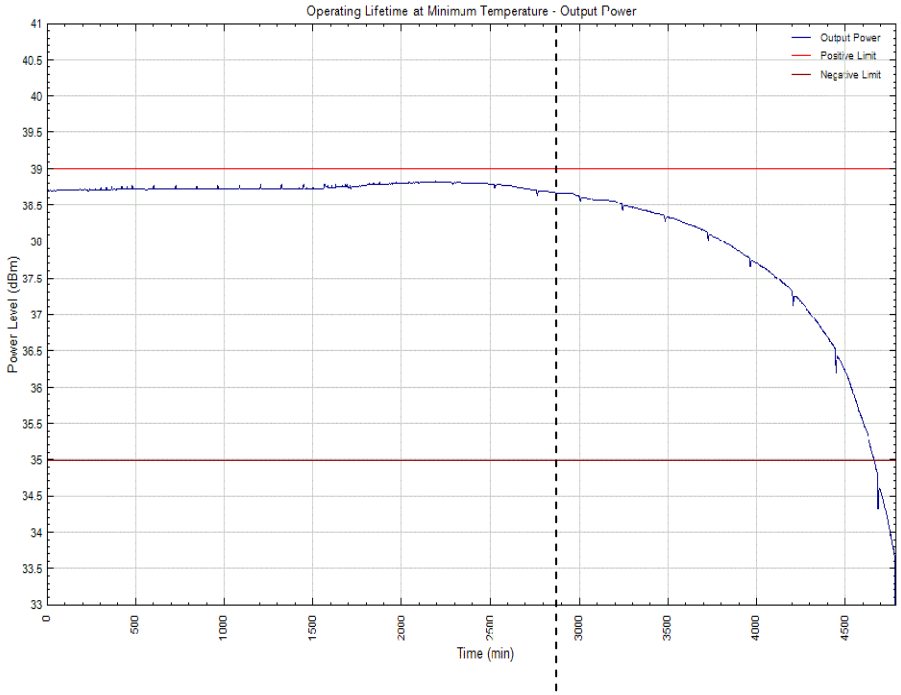


Medium Term Stability, Residual Frequency Variation



48 Hours

Output Power



48 Hours

Product Service

Digital Message

Full 36 hex message	FFFE2F8C9EF9C0637FDFF83D15B783E0F66C

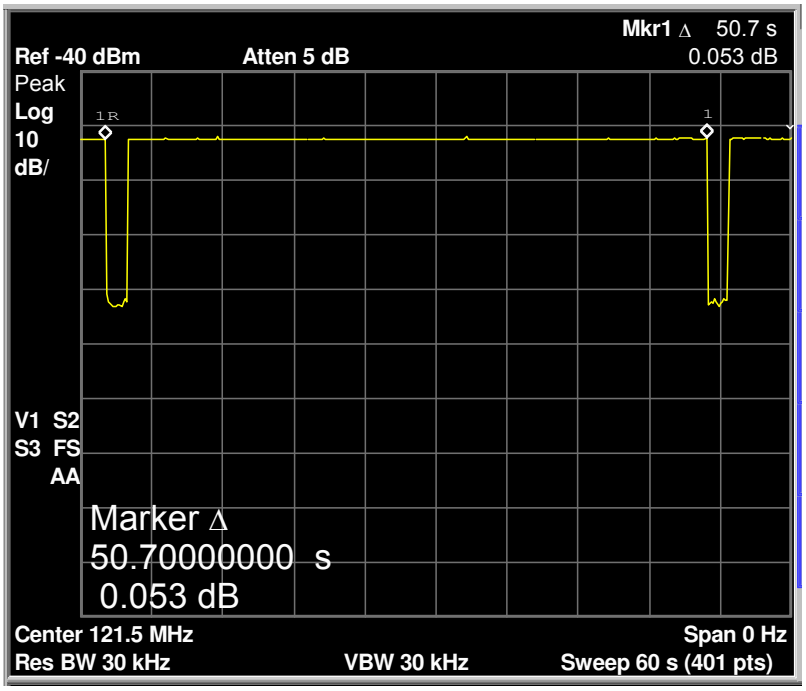
ITEM	BITS	VALUE
Message format: long format	25	1
Protocol: Location Protocol	26	0
Country code: 201 - **Albania**	27-36	0011001001
Type of location protocol: Standard Location - Test	37-40	1110
Test Protocol: Test Protocol (No Decode information in bits 41 to 64)	41-64	111110011100000001100011
Latitude Sign: default	65	0
Latitude Degrees: default	66-72	1111111
Latitude Minutes: default	73-74	11
Longitude Sign: default	75	0
Longitude Degrees: default	76-83	11111111
Longitude Minutes: default	84-85	11
BCH 1 Encoded:	86-106	00000111101000101010
BCH 1 Calculated:	N/A	00000111101000101010
Fixed bits (1101): Pass	107-110	1101
Position Data: Encoded Position Data Source From Internal Navigation Device	111	1
Aux Device: 121.5 MHz homer	112	1
Latitude Offset Sign: default	113	1
Latitude Offset Minutes: default	114-118	00000
Latitude Offset Seconds: default	119-122	1111
Longitude Offset Sign: default	123	1
Longitude Offset Minutes: default	124-128	00000
Longitude Offset Seconds: default	129-132	1111
BCH 2 Encoded:	133-144	011001101100
BCH 2 Calculated:	N/A	011001101100
Composite Latitude: default	N/A	Composite Longitude: default
15 Hex ID:	N/A	193DF380C6FFBFF

Test Data (0 min - 30 min)

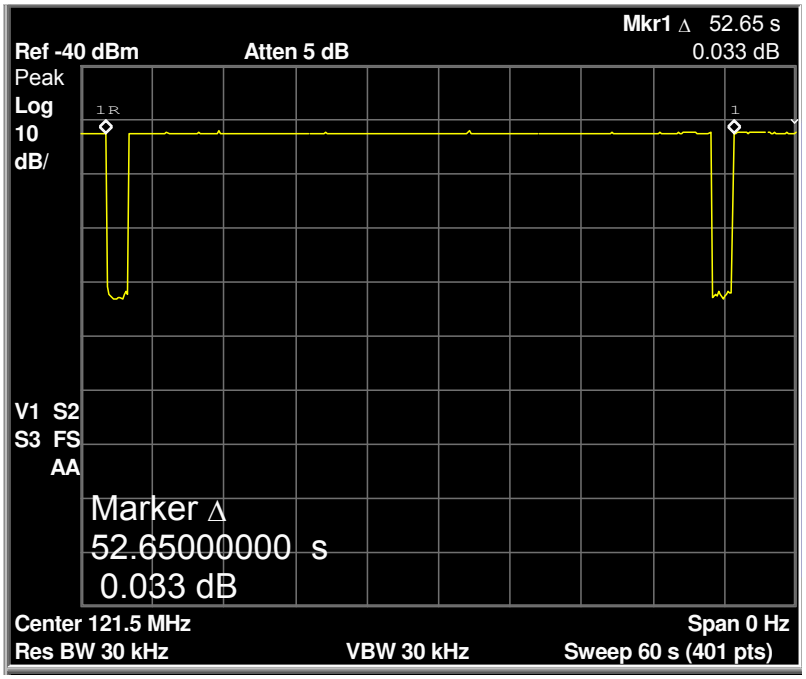
Burst	Power	Frequency	STS	MTS-Slope	MTS-Var	Time Hrs
1	38.73	-	-	-	-	0
2	38.72	-	-	-	-	0.013722
3	38.72	-	-	-	-	0.027222
4	38.72	-	-	-	-	0.041083
5	38.72	-	-	-	-	0.055611
6	38.71	-	-	-	-	0.069639
7	38.71	-	-	-	-	0.083444
8	38.71	-	-	-	-	0.0975
9	38.71	-	-	-	-	0.111222
10	38.71	-	-	-	-	0.124639
11	38.71	-	-	-	-	0.138139
12	38.71	-	-	-	-	0.152306
13	38.71	-	-	-	-	0.16575
14	38.71	-	-	-	-	0.179889
15	38.71	-	-	-	-	0.194194
16	38.71	-	-	-	-	0.207556
17	38.71	-	-	-	-	0.221917
18	38.71	406.0400274	1.13E-10	-5.52E-09	1.37E-08	0.236444
19	38.71	406.0400257	1.19E-10	-4.63E-09	1.38E-08	0.250278
20	38.71	406.0400241	1.21E-10	-3.69E-09	1.31E-08	0.264306
21	38.71	406.0400227	1.13E-10	-2.73E-09	1.16E-08	0.278028
22	38.71	406.0400214	1.14E-10	-1.82E-09	9.38E-09	0.292306
23	38.71	406.0400204	1.12E-10	-1.02E-09	6.42E-09	0.30675
24	38.71	406.0400197	1.07E-10	-4.17E-10	3.11E-09	0.32025
25	38.71	406.0400193	1.09E-10	-1.24E-10	6.76E-10	0.334361
26	38.71	406.0400192	9.09E-11	-7.78E-11	3.25E-10	0.348389
27	38.71	406.0400192	8.57E-11	-7.41E-11	3.16E-10	0.362667
28	38.71	406.0400191	8.57E-11	-9.05E-11	2.95E-10	0.376722
29	38.71	406.0400191	9.09E-11	-1.06E-10	2.44E-10	0.390667
30	38.71	406.0400191	9.09E-11	-1.16E-10	1.90E-10	0.404222
31	38.71	406.0400191	1.04E-10	-1.16E-10	1.92E-10	0.41775
32	38.71	406.0400191	1.00E-10	-1.03E-10	2.37E-10	0.431889
33	38.71	406.040019	1.00E-10	-8.52E-11	2.85E-10	0.446278
34	38.71	406.040019	9.36E-11	-6.79E-11	2.94E-10	0.459583
35	38.71	406.040019	1.03E-10	-4.73E-11	3.20E-10	0.473972
36	38.71	406.040019	1.00E-10	-2.60E-11	3.20E-10	0.488278

121 Homing Transmitter - Duty Cycle (Start of Test)

On Time



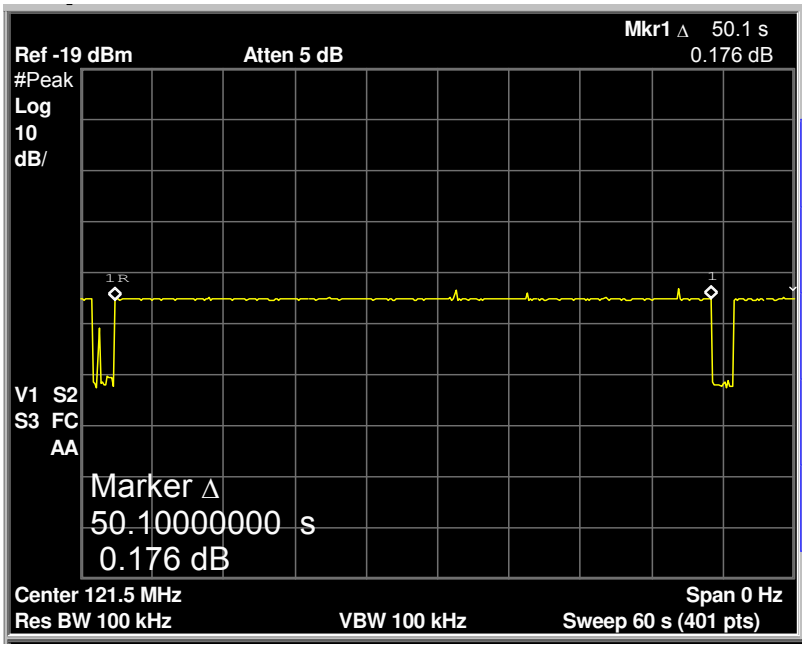
Off Time



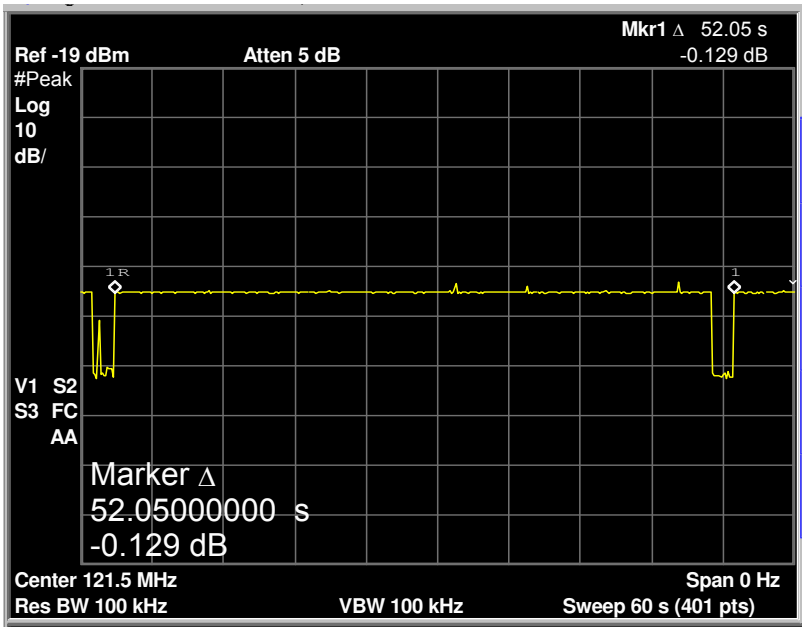
Duty Cycle = 50.7 / 52.65 = 0.962 = 96.2%

121 Homing Transmitter - Duty Cycle (End of Test)

On Time

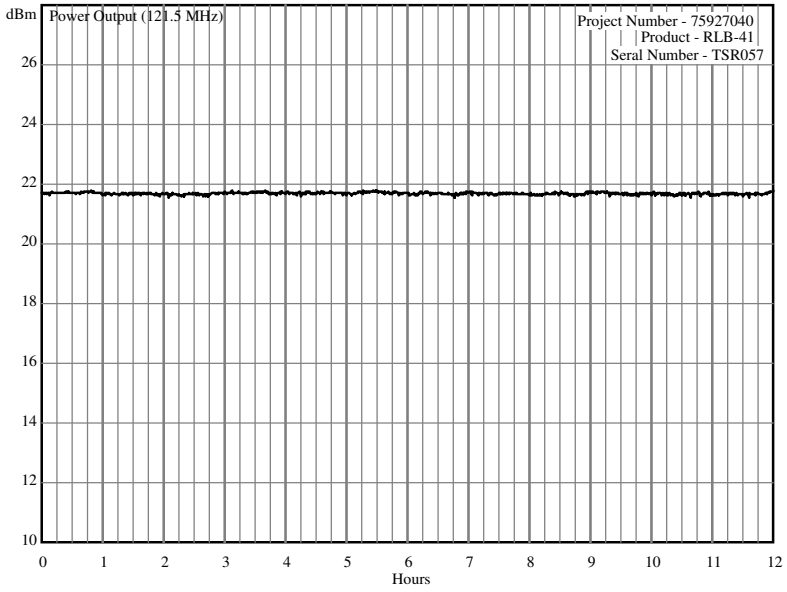


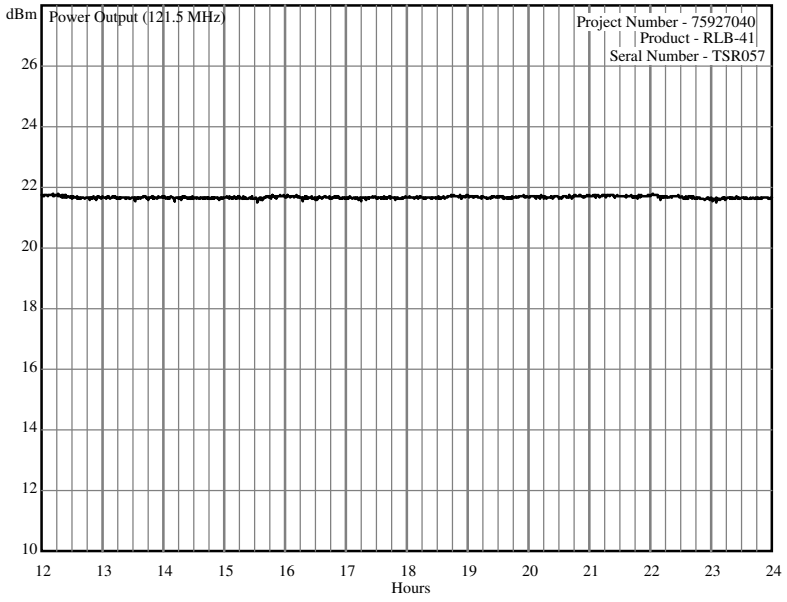
Off Time



Duty Cycle = 50.1 / 52.05 = 0.962 = 96.2%

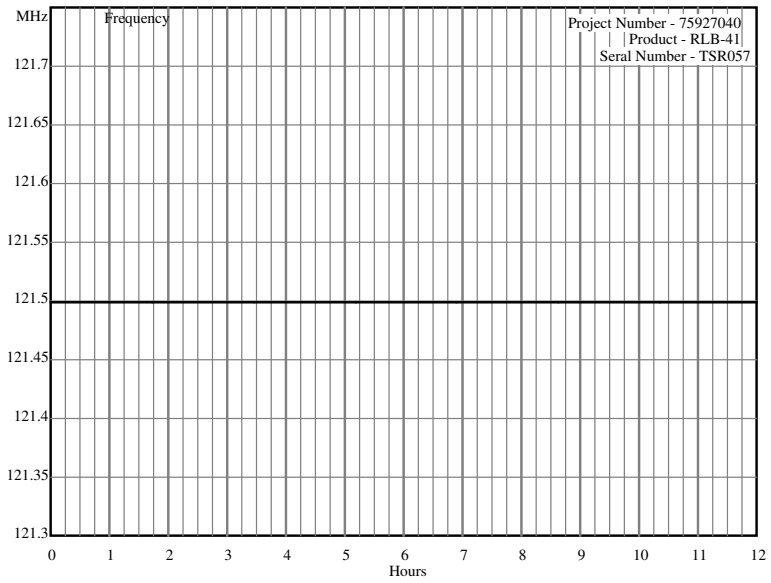
121 Homing Transmitter Power (First 24 Hours of Operation)

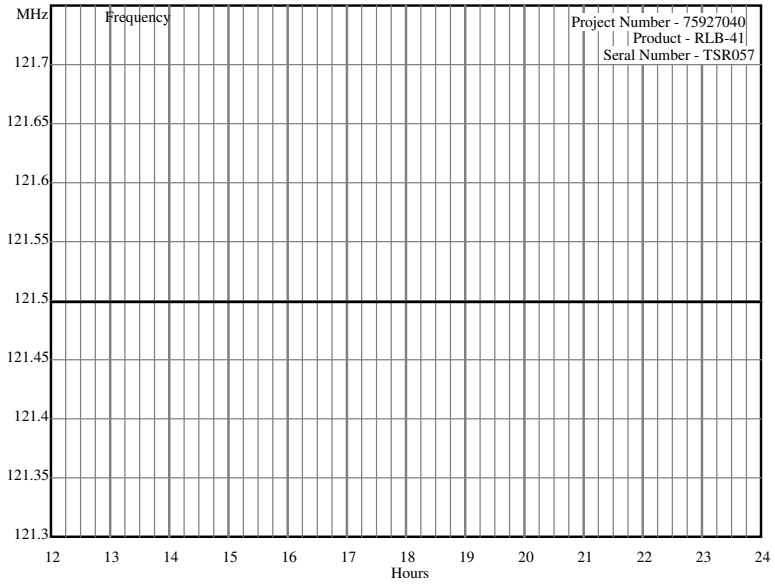




Product Service

121 Homing Transmitter Frequency (First 24 Hours of Operation)





Product Service

Beacon Operating Current

As per C/S T.007 Table F-E.1:

Beacon Operating Modes	Mode: Manually selectable or Automatic	Measurement interval, sec	Average Current, mA	Peak Current, mA
Standby Modes				
No Ancillaries (Standalone) - Standby	A	900	0.00007	0.00015
Manual release bracket - Standby	A	900	0.00006	0.00008
Automatic Release Case - Standby	A	900	0.00006	0.00008
Operating 'ON' Modes				
No Ancillaries (Standalone) - ON at EUT switch (see note below)	M	2007	46.46	1535
Manual release bracket - ON at EUT switch	M	2008	46.07	1505
Automatic Release Case - ON at EUT switch	M	2008	46.11	1509
No Ancillaries (Standalone) - ON at Water Contacts	A	1921	46.38	1492
Operating 'ON' Modes (GPS Receiver Sleep)				
No Ancillaries (Standalone) - ON at EUT (GPS Sleep) (see note below)	M	602	37.62	1525
Manual release bracket - ON at EUT (GPS Sleep)	M	602	36.58	1485
Automatic Release Case - ON at EUT (GPS Sleep)	M	602	36.60	1507
No Ancillaries (Standalone) - ON at Water Contacts (GPS Sleep)	A	602	36.66	1482
Self-test Modes				
No Ancillaries (Standalone) - Self-test	M	10.41	88.03	1561
Manual release bracket - Self-test	M	10.72	82.09	1553
Automatic Release Case - Self-test	M	10.64	81.54	1467
GNSS Self-test Modes				
No Ancillaries (Standalone) - GNSS Self-test	M	131.8	30.99	1482
Manual release bracket - GNSS Self-test	M	131.8	31.36	1518
Automatic Release Case - GNSS Self-test	M	131.7	32.32	1669

At all times the sampling interval was 80 ms nominal.

'No Ancillaries (Standalone) - ON at EUT switch' was the operating mode during the Operating Lifetime test.

'No Ancillaries (Standalone) - ON at EUT (GPS Sleep)' is the lower average current mode; hence, this was the figure used for the calculating the Operating Lifetime pre-test Discharge (giving a longer discharge time). During pre-test discharge (and test itself) the operating mode was * 'No Ancillaries (Standalone) - ON at EUT switch' giving an "over-test" on the discharge.

Product Service

Battery Current Measurement Results

Battery Discharge Current:

The discharge current for the batteries was measured for each of the following beacon states.

Beacon in the Off or Standby State, "Standby Current"
Beacon performing a Self-test, "Self-test Current"
Beacon performing a GNSS Self-test, "GNSS ST Current"
Beacon activated and transmitting, "Operating Current"

The individual tests were conducted for the following durations:

Standby Current	:	15 minutes	(899932 ms)
Self-test Current	:	10 seconds	(10406 ms)
GNSS ST Current	:	132 seconds	(131689 ms)
Operating Current	:	10 minutes	(602320 ms)

Assumptions / Supplied Data:

Battery Shelf-life	: 0.25
Battery Replacement Interval	: 10 years
Total Battery Life	: 10.25 years
Battery Capacity	: 4.2 Ah
Battery Self Drain	: 1.00 % per year
Self-test Interval	: 12 tests per year
GNSS Self-test Interval	: 8.4 tests per year

Test Results:

Mode Current	=	Accumulated Charge / Time		
Standby Current	=	69722627.76 pC / 899932 ms	=	77.48 nA
Self-test Current	=	916040.66 uC / 10406 ms	=	88.03 mA
GNSS ST Current	=	4256608.01 uC / 131689 ms	=	32.32 mA
Operating Current	=	22658450.39 uC / 602320 ms	=	37.62 mA

Battery Preconditioning / Discharge Time Calculations:

Battery Self Drain = Capacity - [(100% - Self Drain/Year%)$^{\text{Replacement Interval}}$ x Capacity]
= 4.2- ((1- 0.0100) $^{10.25}$ x 4.2) = 0.4111 Ah

Standby Drain = Hours per year x Battery Replacement Interval x Standby Current
= 365 x 24 x 10 x 77.4754 x 10^{-9} = 0.0068 Ah
Worst Case = 1.65 x 0.0068 Ah = 0.0112 Ah

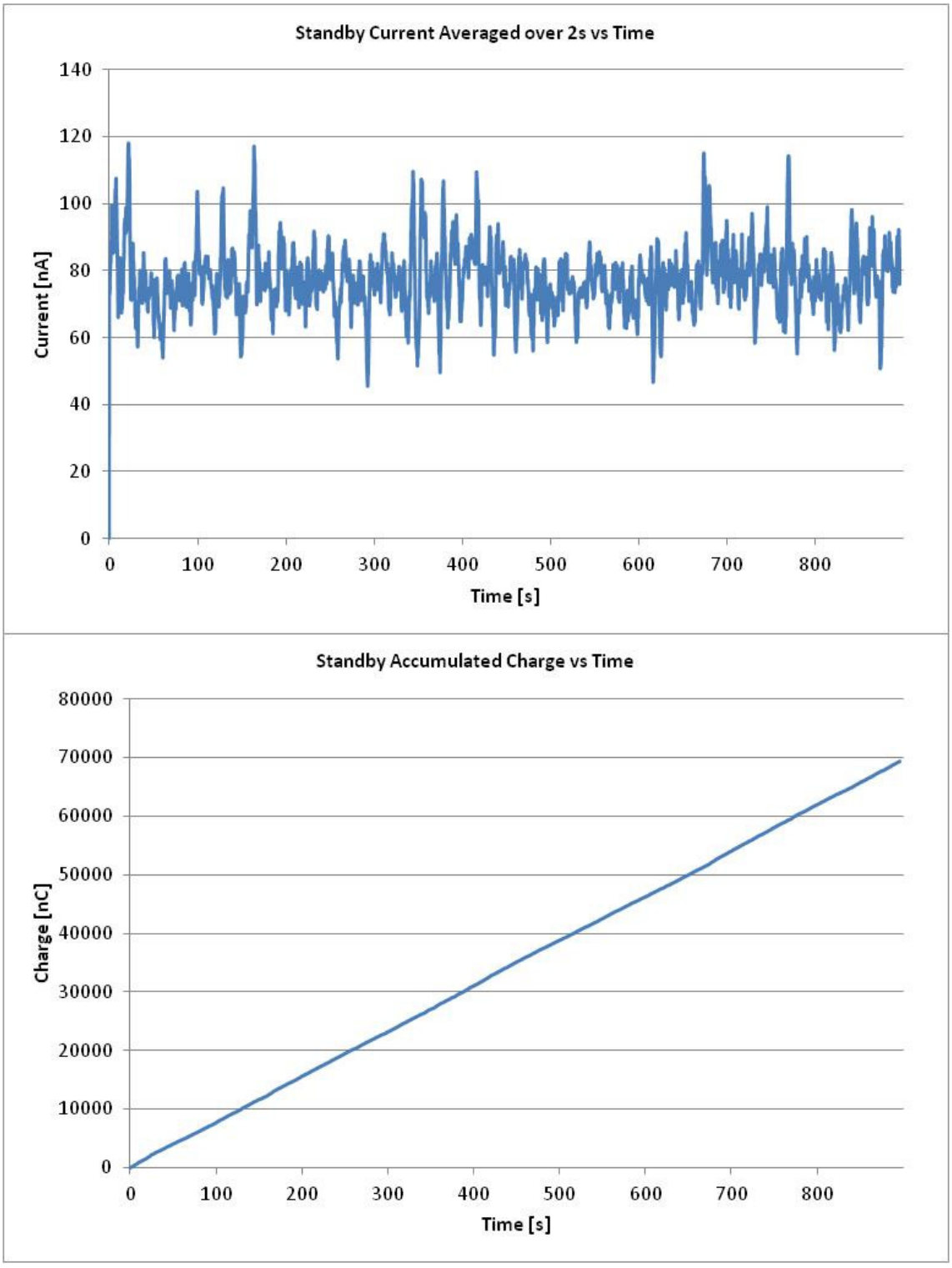
Self-test Drain = Self-tests per battery x Self-test Current x Self-test duration (in hours)
= 12 x 10 x 88.03 x 10^{-3} x (10.4 / 3600) = 0.0305 Ah
Worst Case = 1.65 x 0.0305 Ah = 0.0504 Ah

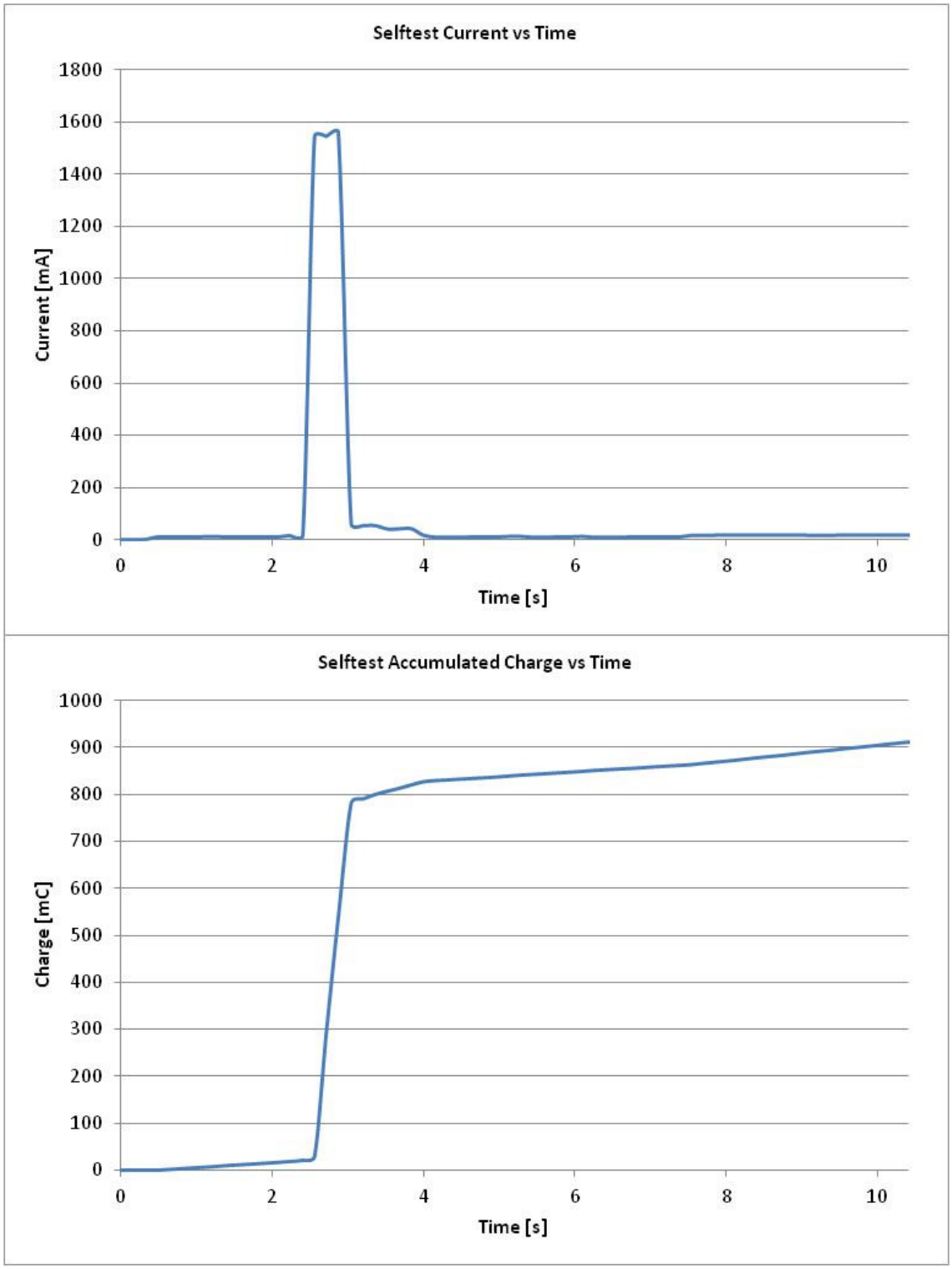
GNSS ST Drain = Self-tests per battery x Self-test Current x Self-test duration (in hours)
= 8.4 x 10 x 32.32 x 10^{-3} x (132 / 3600) = 0.0993 Ah
Worst Case = 1.65 x 0.0993 Ah = 0.1639 Ah

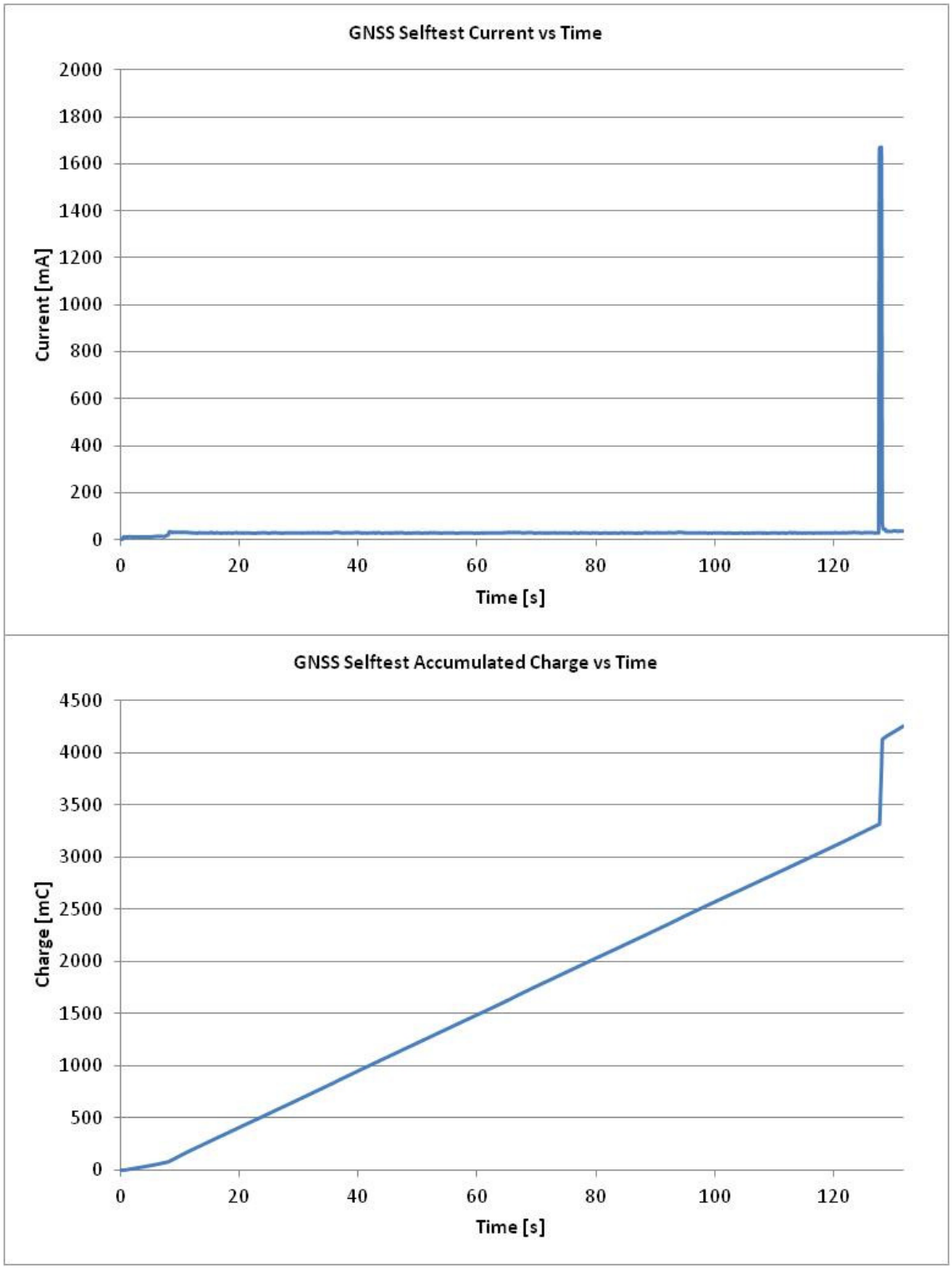
Total Drain = Self Drain + Standby Drain (Worst Case) + Self-test Drain (Worst Case)
= 0.4111 + 0.0112 + 0.0504 + 0.1639 = 0.6366 Ah

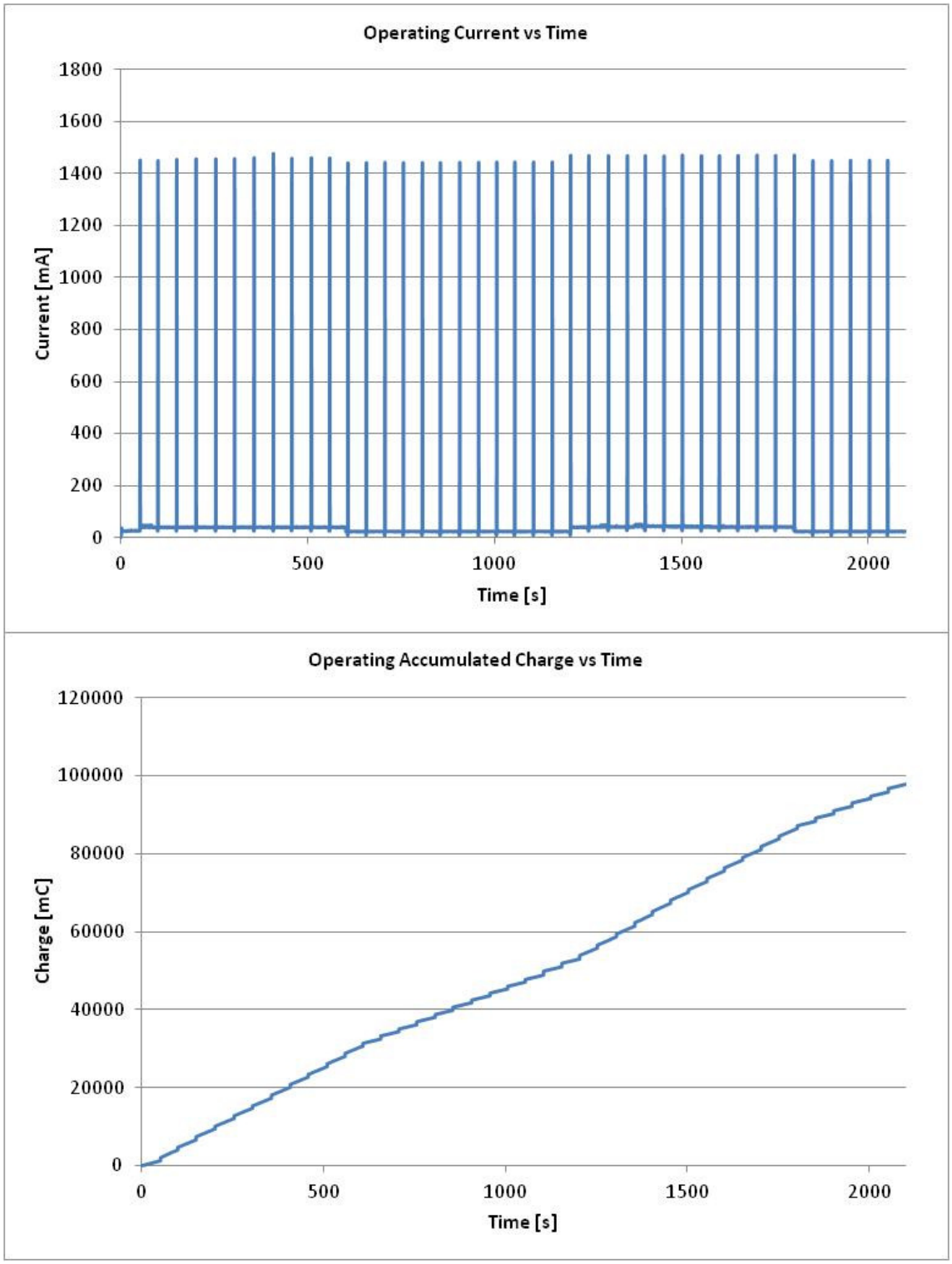
Battery Preconditioning / Discharge Time = Worst Case drain / Operational Current
= 0.6366 / (37.62 x 10^{-3})
= 16.92 hours

Battery Current Graphs




Selftest Current vs Time
Current [mA]
1800
1600
1400
1200
1000
800
600
400
200
0
0
2
4
6
8
10
Time [s]
Selftest Accumulated Charge vs Time
Charge [mC]
1000
900
800
700
600
500
400
300
200
100
0
0
2
4
6
8
10
Time [s]


GNSS Selftest Current vs Time
Current [mA]
2000
1800
1600
1400
1200
1000
800
600
400
200
0
0
20
40
60
80
100
120
Time [s]
GNSS Selftest Accumulated Charge vs Time
Charge [mC]
4500
4000
3500
3000
2500
2000
1500
1000
500
0
0
20
40
60
80
100
120
Time [s]


Operating Current vs Time
Current [mA]
1800
1600
1400
1200
1000
800
600
400
200
0
0
500
1000
1500
2000
Time [s]
Operating Accumulated Charge vs Time
Charge [mC]
120000
100000
80000
60000
40000
20000
0
0
500
1000
1500
2000
Time [s]

2.8 FREQUENCY STABILITY TEST WITH TEMPERATURE GRADIENT

2.8.1 Specification

Cospas-Sarsat T.007, Clause A.2.4

2.8.2 Equipment Under Test and Modification State

RLB-41 S/N: #36 - Modification State 0

2.8.3 Date of Test

13 & 14 March 2015

2.8.4 Test Equipment Used

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

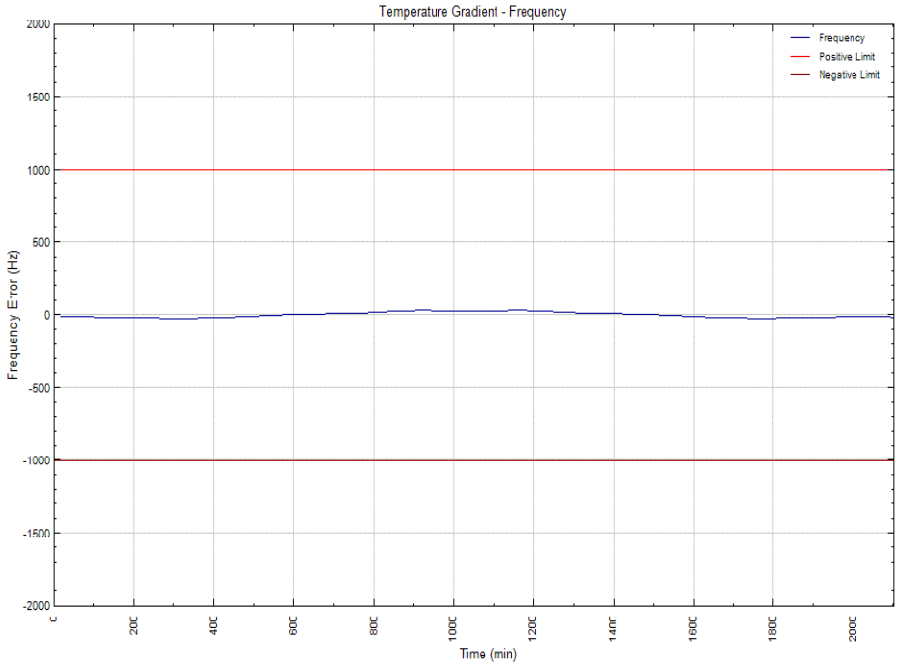
2.8.5 Environmental Conditions

Ambient Temperature 22.0 - 22.9°C
Relative Humidity 31.2 - 35.8%

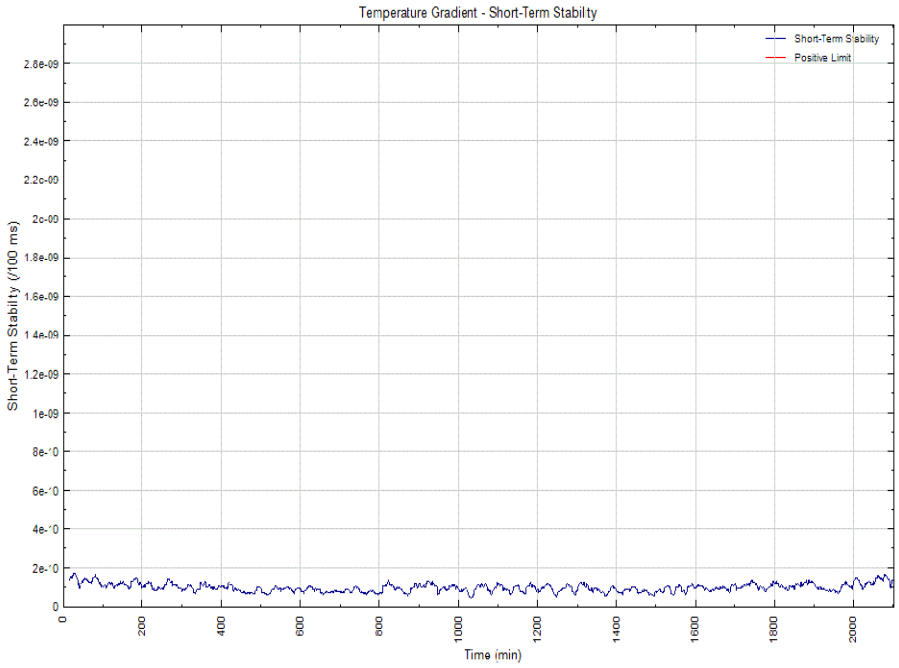
2.8.6 Test Results

Full Test

Nominal Frequency

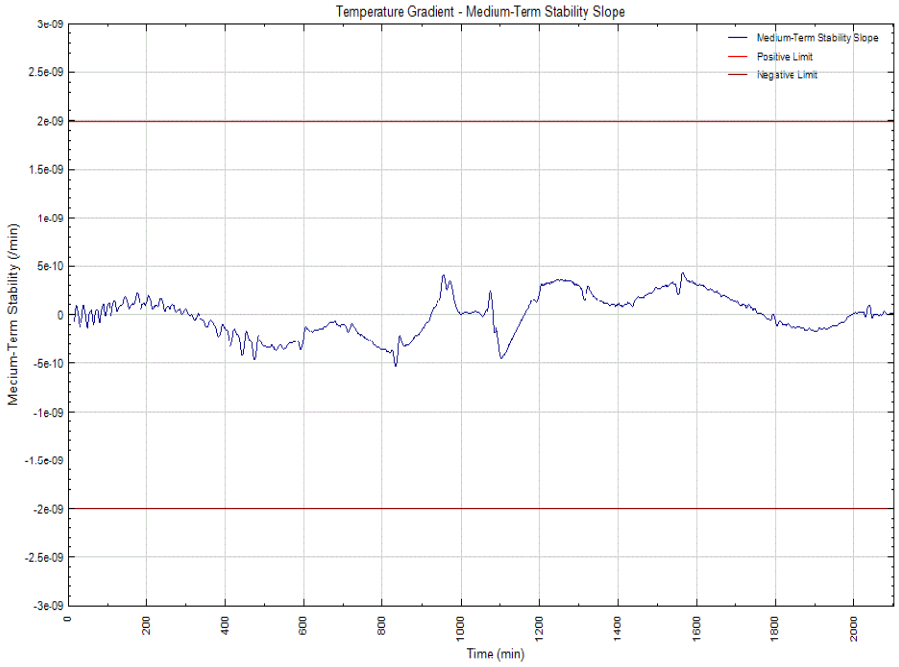


Short Term Stability

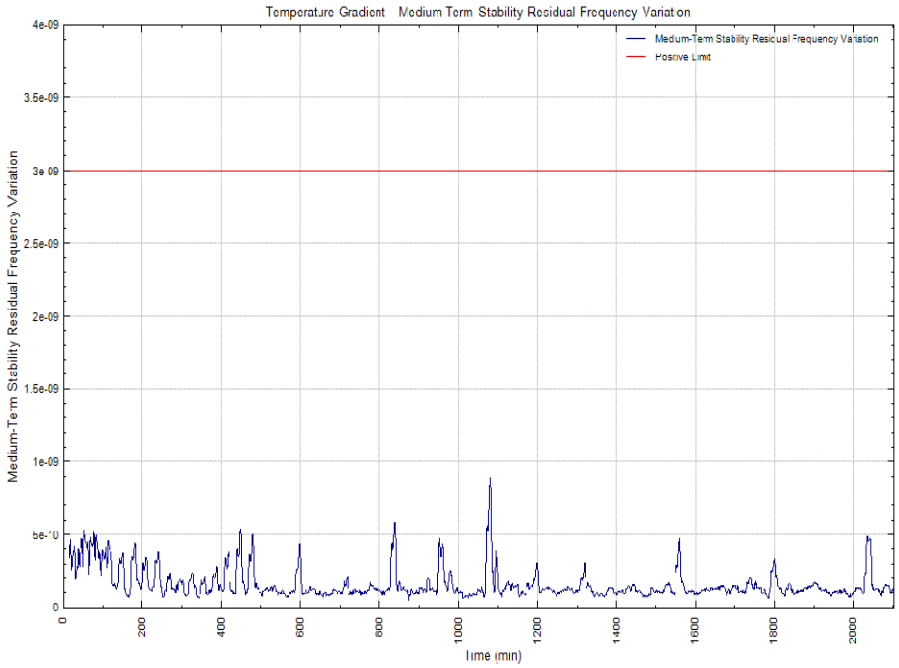


Product Service

Medium Term Stability, Mean Slope

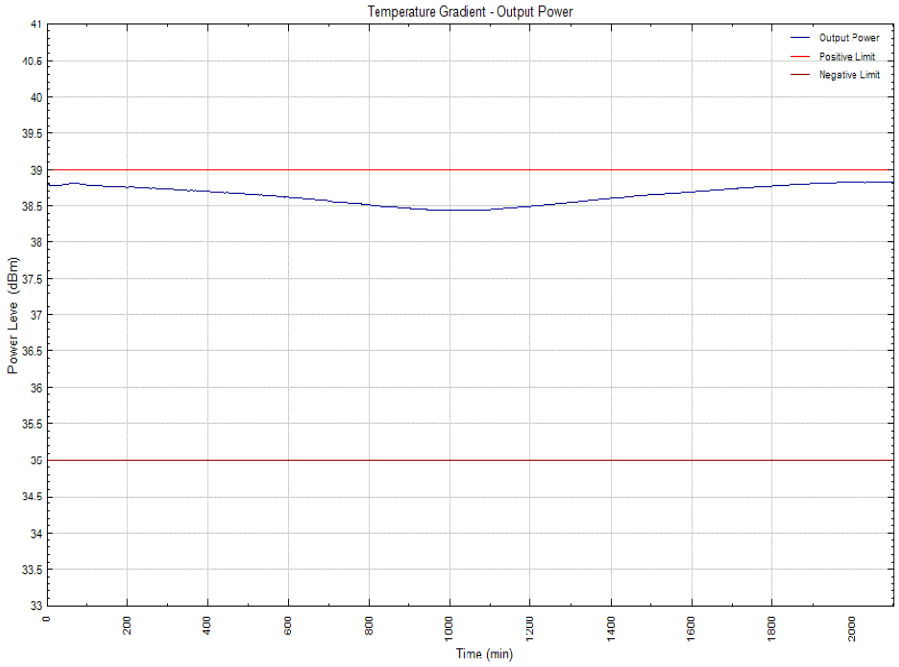


Medium Term Stability, Residual Frequency Variation



Product Service

Output Power



Product Service

Digital Message

Full 36 hex message	FFFE2F8C9EF9C0637FDFF83D15B783E0F66C

ITEM	BITS	VALUE
Message format: long format	25	1
Protocol: Location Protocol	26	0
Country code: 201 - **Albania**	27-36	0011001001
Type of location protocol: Standard Location - Test	37-40	1110
Test Protocol: Test Protocol (No Decode information in bits 41 to 64)	41-64	111110011100000001100011
Latitude Sign: default	65	0
Latitude Degrees: default	66-72	1111111
Latitude Minutes: default	73-74	11
Longitude Sign: default	75	0
Longitude Degrees: default	76-83	11111111
Longitude Minutes: default	84-85	11
BCH 1 Encoded:	86-106	00000111010001010110
BCH 1 Calculated:	N/A	00000111010001010110
Fixed bits (1101): Pass	107-110	1101
Position Data: Encoded Position Data Source From Internal Navigation Device	111	1
Aux Device: 121.5 MHz homer	112	1
Latitude Offset Sign: default	113	1
Latitude Offset Minutes: default	114-118	00000
Latitude Offset Seconds: default	119-122	1111
Longitude Offset Sign: default	123	1
Longitude Offset Minutes: default	124-128	00000
Longitude Offset Seconds: default	129-132	1111
BCH 2 Encoded:	133-144	011001101100
BCH 2 Calculated:	N/A	011001101100
Composite Latitude: default	N/A	Composite Longitude: default
15 Hex ID:	N/A	193DF380C6FFBFF

Interim TCXO Procedure Summary

Full test

TCXO Part Number*: E5344LF

TCXO S/N*: 1312

* As advised by the Manufacturer

MTS Characteristic	Time (h)	Temp. (°C)	tot	osc	beacon_wc	MAX-OSC	beacon_max	Ageing factor	beacon_5 year	Limit	Result
Residual	17.98	50.70	8.935E-10	3.621E-10	8.168E-10	2.000E-09	2.160E-09	2.00E-10	2.360E-09	3.0E-09	Pass
Static Positive Mean Slope	17.52	52.9	-4.60E-12	-4.046E-10	4.045E-10	7.00E-10	8.085E-10	1.00E-10	9.085E-10	1.0E-09	Pass
Static Negative Mean Slope	0.82	-20.0	-1.33E-10	-2.107E-11	-1.309E-10	-7.00E-10	-7.121E-10	-1.00E-10	-8.121E-10	-1.0E-09	Pass
Gradient Positive Mean Slope	26.06	10.5	4.42E-10	1.334E-10	4.215E-10	1.7E-09	1.751E-09	1.00E-10	1.851E-09	2.0E-09	Pass
Gradient Negative Mean Slope	13.86	44.0	-5.26E-10	-2.178E-10	-4.789E-10	-1.7E-09	-1.766E-09	-1.00E-10	-1.866E-09	-2.0E-09	Pass

2.9 SATELLITE QUALITATIVE TESTS

2.9.1 Specification

Cospas-Sarsat T.007, Clause A.2.5

2.9.2 Equipment Under Test and Modification State

RLB-41 S/N: 26 - Modification State 0

2.9.3 Date of Test

5 May 2015, 6 May 2015, 7 May 2015 & 8 May 2015

2.9.4 Test Equipment Used

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

2.9.5 Environmental Conditions

Ambient Temperature 12.5 - 17.2°C
Relative Humidity 55.1 - 69.0%

2.9.6 Test Results

Configuration 5

Test Start: 2015:05:07 18:28:53
Test End: 2015:05:08 08:16:24
15 Hex ID: 193DF380C6FFBFF

Actual location of the test beacon: 50.818263
(Daedalus Airfield, Lee-on-the-Solent, West) -1.197454

Satellite ID	Satellite Pass Number	15 Hex ID Provided by LUT	Doppler Latitude	Doppler Longitude	Mean Rx Power (dBm)	TCA	CTA (deg)	Location Error (km)
S7	88308	193DF 380C6 FFBFF	50.83315	-1.18584	-126.65	17:45:43	-9.394	1.844
S10	51337	193DF 380C6 FFBFF	50.82687	-1.18904	-128.11	18:11:49	-18.231	1.124
S11	44353	193DF 380C6 FFBFF	50.82801	-1.22859	-130.74	18:25:43	20.128	2.439
S13	13669	193DF 380C6 FFBFF	50.83031	-1.19604	-128.75	19:18:37	13.796	1.342
S11	44354	193DF 380C6 FFBFF	50.82818	-1.20517	-125.51	20:04:29	7.136	1.228
S13	13671	193DF 380C6 FFBFF	50.82807	-1.20214	-131.12	22:38:59	-16.557	1.138
S11	44355	193DF 380C6 FFBFF	50.72162	-0.91433	-122.03	21:44:35	-8.415	22.611
S12	32183	193DF 380C6 FFBFF	50.81564	-1.20968	-128.61	01:59:25	-9.246	0.907
S12	32184	193DF 380C6 FFBFF	50.82016	-1.19458	-114.74	03:40:16	6.294	0.292
S7	88314	193DF 380C6 FFBFF	50.80800	-1.20146	-132.28	04:14:43	-18.559	1.175
S10	51343	193DF 380C6 FFBFF	50.80943	-1.20791	-127.94	04:46:43	-9.428	1.226
S12	32185	193DF 380C6 FFBFF	50.81303	-1.19934	-128.45	05:19:43	19.466	0.596
S7	88315	193DF 380C6 FFBFF	50.80894	-1.21320	-126.50	05:55:30	-2.659	1.515
S10	51344	193DF 380C6 FFBFF	50.81281	-1.20105	-126.87	06:27:34	6.101	0.656
S7	88316	193DF 380C6 FFBFF	50.80692	-1.18986	-126.94	07:34:52	12.058	1.369

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

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

$$= \frac{14}{15}$$

$$= 93.3\%$$

Configuration 7

Test Start: 2015:05:05 16:00:00
Test End: 2015:05:06 07:00:00
15 Hex ID: 193DF380C6FFBFF

Actual location of the test beacon: 50.818263
(Daedalus Airfield, Lee-on-the-Solent, West) -1.197454

Satellite ID	Satellite Pass Number	15 Hex ID Provided by LUT	Doppler Latitude	Doppler Longitude	Mean Rx Power (dBm)	TCA	CTA (deg)	Location Error (km)
S10	51308	193DF 380C6 FFBFF	59.38745	-5.08204	-133.53	16:55:43	-5.229	983.333
S7	88279	193DF 380C6 FFBFF	50.81721	-1.18681	-124.63	16:55:10	-1.468	0.756
S7	88280	193DF 380C6 FFBFF	50.82339	-1.18782	-132.08	18:35:51	-17.341	0.884
S11	44325	193DF 380C6 FFBFF	50.82601	-1.21604	-134.93	19:06:25	15.172	1.563
S13	13641	193DF 380C6 FFBFF	50.81036	-1.19621	-129.70	19:59:37	8.105	0.883
S13	13642	193DF 380C6 FFBFF	50.81242	-1.18306	-135.54	21:39:40	-7.183	1.201
S11	44327	193DF 380C6 FFBFF	50.82194	-1.19346	-130.96	22:26:30	-14.881	0.496
S12	32155	193DF 380C6 FFBFF	50.81536	-1.20159	-131.14	02:22:00	-5.650	0.434
S12	32156	193DF 380C6 FFBFF	50.81612	-1.19583	-129.57	04:02:33	9.523	0.264
S10	51315	193DF 380C6 FFBFF	50.80737	-1.21060	-130.24	05:09:52	-5.726	1.522
S10	51316	193DF 380C6 FFBFF	50.80899	-1.20050	-129.46	06:50:23	9.430	1.052
S7	88286	193DF 380C6 FFBFF	50.82255	-1.19741	-125.81	05:04:54	-10.609	0.476
S7	88287	193DF 380C6 FFBFF	50.82392	-1.18449	-124.56	06:44:58	4.922	1.106

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

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

$$= \frac{12}{13}$$

$$= 92.3\%$$

Product Service

Configuration 8

Test Start: 2015:05:06 16:00:00
Test End: 2015:05:07 06:45:00
15 Hex ID: 193DF380C6FFBFF

Actual location of the test beacon: 50.818263
(Daedalus Airfield, Lee-on-the-Solent, West) -1.197454

Satellite ID	Satellite Pass Number	15 Hex ID Provided by LUT	Doppler Latitude	Doppler Longitude	Mean Rx Power (dBm)	TCA	CTA (deg)	Location Error (km)
S7	88286	193DF 380C6 FFBFF	50.82255	-1.19741	-125.81	05:04:54	-10.609	0.476
S7	88287	193DF 380C6 FFBFF	50.82392	-1.18449	-124.56	06:44:58	4.922	1.106
S7	88293	193DF 380C6 FFBFF	50.83441	-1.56327	-126.11	16:30:27	2.561	25.741
S10	51322	193DF 380C6 FFBFF	50.83225	-1.18306	-125.68	16:41:41	-4.028	1.854
S7	88294	193DF 380C6 FFBFF	50.83343	-1.18580	-126.14	18:10:44	-13.365	1.873
S10	51323	193DF 380C6 FFBFF	50.83542	-1.18122	-126.60	18:23:31	-20.092	2.221
S11	44339	193DF 380C6 FFBFF	50.82577	-1.21670	-126.79	18:46:02	17.735	1.588
S13	13655	193DF 380C6 FFBFF	50.82417	-1.20850	-129.06	19:39:05	11.020	1.016
S13	13656	193DF 380C6 FFBFF	50.82480	-1.18875	-122.90	21:18:51	-3.901	0.949
S11	44340	193DF 380C6 FFBFF	50.45093	-1.59040	-113.60	20:25:01	4.455	49.329
S11	44341	193DF 380C6 FFBFF	50.82784	-1.18910	-125.44	22:05:32	-11.564	1.215
S13	13657	193DF 380C6 FFBFF	50.83661	-1.20984	-131.37	23:00:04	-19.855	2.216
S12	32169	193DF 380C6 FFBFF	50.81503	-1.20320	-125.90	02:10:43	-7.442	0.540
S7	88300	193DF 380C6 FFBFF	50.80245	-1.20077	-127.64	04:39:52	-14.588	1.773
S10	51329	193DF 380C6 FFBFF	50.81061	-1.20966	-126.52	04:58:18	-7.573	1.207
S12	32170	193DF 380C6 FFBFF	50.85201	-0.81560	-119.65	03:51:23	8.122	27.060
S12	32171	193DF 380C6 FFBFF	50.82377	-1.19434	-121.26	05:30:42	20.698	0.650
S7	88301	193DF 380C6 FFBFF	50.80493	-1.16455	-121.13	06:20:17	1.208	2.745
S10	51330	193DF 380C6 FFBFF	50.82409	-1.19381	-115.14	06:38:59	7.780	0.696

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

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

$$= \frac{16}{19}$$

$$= 84.2\%$$

2.10 BEACON ANTENNA TEST

2.10.1 Specification

Cospas-Sarsat T.007, Clause A.2.6

2.10.2 Equipment Under Test and Modification State

RLB-41 S/N: 26 - Modification State 0

2.10.1 Date of Test

12 February 2015

2.10.2 Test Equipment Used

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

2.10.3 Environmental Conditions

Ambient Temperature 18.6°C
Relative Humidity 34.0%

2.10.4 Test Results

Configuration 1

	Elevation Angle (degrees)									
	10		20		30		40		50	
Azimuth Angle (Degrees)	EIRP dBm	Ant dBi	EIRP dBm	Ant dBi	EIRP dBm	Ant dBi	EIRP dBm	Ant dBi	EIRP dBm	Ant dBi
0	38.1	-0.5	39.6	1.0	41.8	3.3	38.6	0.1	33.0	-5.5
30	38.1	-0.5	39.5	0.9	41.7	3.2	38.6	0.0	32.9	-5.7
60	37.8	-0.8	39.5	0.9	41.8	3.3	38.6	0.1	33.1	-5.5
90	37.9	-0.6	39.6	1.1	41.9	3.3	38.6	0.0	33.1	-5.4
120	37.8	-0.8	39.7	1.1	42.0	3.4	38.7	0.1	32.9	-5.6
150	37.8	-0.8	39.7	1.1	41.8	3.3	38.5	0.0	33.4	-5.2
180	37.6	-1.0	39.7	1.1	42.0	3.5	38.5	-0.1	33.0	-5.5
210	37.9	-0.6	39.6	1.0	41.8	3.3	38.5	0.0	32.8	-5.7
240	37.9	-0.7	39.4	0.8	41.8	3.2	38.5	-0.1	33.2	-5.3
270	37.8	-0.7	39.4	0.9	41.9	3.4	38.5	0.0	32.9	-5.6
300	38.0	-0.6	39.4	0.9	41.9	3.3	38.6	0.1	32.5	-6.0
330	38.0	-0.6	39.6	1.0	41.9	3.3	38.6	0.1	32.8	-5.8

	Elevation Angle (degrees)									
	10		20		30		40		50	
Azimuth Angle (Degrees)	Vv	Vh	Vv	Vh	Vv	Vh	Vv	Vh	Vv	Vh
0	109.8	78.8	110.9	80.0	112.4	79.4	108.1	83.6	100.9	82.0
30	109.8	83.8	110.7	77.9	112.3	70.5	108.1	85.3	100.8	84.2
60	109.5	79.8	110.8	79.4	112.4	74.4	108.1	85.0	101.0	80.3
90	109.6	76.3	110.9	73.9	112.5	78.1	108.1	83.7	101.1	77.6
120	109.5	74.0	111.0	76.6	112.6	62.2	108.2	84.3	100.9	82.3
150	109.5	73.7	111.0	77.3	112.4	71.2	108.0	86.0	101.3	79.1
180	109.3	80.0	111.0	80.3	112.6	74.7	108.0	84.6	101.0	82.7
210	109.6	83.2	110.9	81.3	112.4	66.0	108.0	85.7	100.7	86.1
240	109.6	80.8	110.6	78.5	112.4	68.1	107.9	86.5	101.1	85.4
270	109.5	75.7	110.7	80.7	112.5	65.9	108.0	86.3	100.8	85.4
300	109.7	82.3	110.7	71.3	112.5	70.9	108.1	87.2	100.4	84.7
330	109.7	81.2	110.9	73.6	112.5	76.6	108.1	85.8	100.7	78.2
Min (Vv-Vh)	26.0		29.5		33.0		20.9		14.6	

$EIRP_{LOSS} = Pt_{ambient} - Pt_{EOL} =$ 38.54 - 38.65 = -0.11 dB

$EIRP_{maxEOL} = Max[EIRP_{max}, (EIRP_{max} - EIRP_{LOSS})] =$ Max[42.0, 42.1]= 42.1 dBm

$EIRP_{minEOL} = Min[EIRP_{min}, (EIRP_{min} - EIRP_{LOSS})] =$ Min[32.5, 32.6]= 32.5 dBm

Configuration 4

	Elevation Angle (degrees)									
	10		20		30		40		50	
Azimuth Angle (Degrees)	EIRP dBm	Ant dBi	EIRP dBm	Ant dBi	EIRP dBm	Ant dBi	EIRP dBm	Ant dBi	EIRP dBm	Ant dBi
0	37.3	-1.2	39.2	0.6	37.1	-1.4	29.7	-8.8	~~20.5~~	-18.1
90	37.3	-1.2	39.1	0.6	37.1	-1.4	29.9	-8.6	~~19.6~~	-18.9
180	37.3	-1.3	39.1	0.5	37.1	-1.5	30.3	-8.3	~~19.9~~	-18.7
270	37.3	-1.2	39.1	0.6	37.3	-1.2	30.2	-8.4	~~20.9~~	-17.6

$EIRP_{LOSS} = Pt_{ambient} - Pt_{EOL} =$ 38.54 - 38.65 = -0.11 dB

$EIRP_{maxEOL} = Max[EIRP_{max}, (EIRP_{max} - EIRP_{LOSS})] =$ Max[39.2, 39.3]= 39.3dBm

$EIRP_{minEOL} = Min[EIRP_{min}, (EIRP_{min} - EIRP_{LOSS})] =$ Min[29.7, 29.8]= 29.7dBm[Note1]

Note 1:Result within the allowance stated in section A.1 of T.007.

2.11 NAVIGATION SYSTEM TEST

2.11.1 Specification

Cospas-Sarsat T.007, Clause A.2.7

2.11.2 Equipment Under Test and Modification State

RLB-41 S/N: #36 - Modification State 0

2.11.3 Date of Test

31 March 2015, 02 April 2015 & 8 May 2015

2.11.4 Test Equipment Used

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

2.11.5 Environmental Conditions

Ambient Temperature 12.7 - 22.1°C
Relative Humidity 41.0 - 61.5%

2.11.6 Test Results

National 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
FFFE2F8C9F0018DFC0FF04F9E4379F3C0010	36

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

Locations:

A.3.8.2.1:	50° 49.091' N	1° 11.869'W	①
A.3.8.2.2:	50° 52.121'N	1° 14.685'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 (sec)	Location Error in metres	Time to Acquire Position (sec)	Location Error in metres
Configuration 5	50	45.1	50	31.3
Configuration 7	50	45.1	50	31.3
Configuration 8	50	45.1	50	31.3

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 51° 22.583' W 1° 49.833' ①		
Data Acquired at	08:45:30	FFFE2F8C9F0018CCD701C85E1A379208025B
Location: N 50° 48.683' W 1° 37.417' ①		
Data Updated at	09:15:00	FFFE2F8C9F0018CCB1019D9B45F794240FCD
Data Update Interval	29 min 30 s	

① Input from GPS simulator

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 51° 22.583' W 1° 49.833' ①		
Data Acquired at	09:21:42	FFFE2F8C9F0018CCD701C85E1A379208025B
GPS Signal Navigation Data Removed		
Data Updated at	13:22:06	FFFE2F8C9F0018DFC0FF04F9E4379F3C0010
Last Valid Position Held	240min 24s	
Return to Default Position	✓	

① Input from GPS simulator

Product Service

Standard 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
FFFE2F8C9EF9C0637FDFF83D15B783E0F66C	35

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

Locations:

A.3.8.2.1:	50° 49.091' N	1° 11.869'W	①
A.3.8.2.2:	50° 52.121'N	1° 14.685'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 (sec)	Location Error in metres	Time to Acquire Position (sec)	Location Error in metres
Configuration 5	50	45.1	50	31.3
Configuration 7	50	78.4	50	31.3
Configuration 8	50	45.1	50	31.3

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 51° 22.584' W 1° 49.833' ①		
Data Acquired at	11:17:23	FFFE2F8C9EF9C06333A03ECA66771DA4D4D0
Location: N 50° 48.683' W 1° 37.417' ①		
Data Updated at	11:46:43	FFFE2F8C9EF9C06332E0311EC7778EA76951
Data Update Interval	29 min 20 s	

① Input from GPS simulator

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 51° 22.583' W 1° 49.833' ①		
Data Acquired at	11:57:31	FFFE2F8C9EF9C06333A03ECA66771DA4D4D0
GPS Signal Navigation Data Removed		
Data Updated at	15:56:54	FFFE2F8C9EF9C0637FDFF83D15B783E0F66C
Last Valid Position Held	239min 23s	
Return to Default Position	✓	

① Input from GPS simulator

User 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
FFFE2FCC9F2000C6007CEAD04BEFE0FF0146	36

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

Locations:

A.3.8.2.1:	50° 49.091' N	1° 11.869'W	①
A.3.8.2.2:	50° 52.121'N	1° 14.685'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 (sec)	Location Error in metres	Time to Acquire Position (sec)	Location Error in metres
Configuration 5	50	2012.5	50	1553.3
Configuration 7	50	2012.5	50	1553.3
Configuration 8	50	2012.5	50	1553.3

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 51° 22.583' W 1° 49.833' ①		
Data Acquired at	14:18:36	FFFE2FCC9F2000C6007CEAD04BE66D01C026
Location: N 50° 48.683' W 1° 37.417' ①		
Data Updated at	14:48:51	FFFE2FCC9F2000C6007CEAD04BE65901967F
Data Update Interval	30 min 15 s	

① GPS Site Survey – Live Location

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 51° 22.583' W 1° 49.833' ①		
Data Acquired at	14:54:52	FFFE2FCC9F2000C6007CEAD04BE66D01C026
GPS Signal Navigation Data Removed		
Data Updated at	18:55:22	FFFE2FCC9F2000C6007CEAD04BEFE0FF0146
Last Valid Position Held	240min 30s	
Return to Default Position	✓	

① Input from GPS simulator

Product Service

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 2.10 Beacons – Antenna Test					
Turntable Controller	Various	RH253	1708	-	TU
Roberts Antenna 406MHz	Compliance Design		1860	24	27-Feb-2016
Test Receiver	Rohde & Schwarz	ESIB40	2941	12	23-Dec-2015
Section 2.7 Beacons - Battery Current Measurements					
Hygromer	Rotronic	I-1000	2829	12	27-Oct-2015
Termination (50ohm, 15W)	Diamond Antenna	DL-30N	3098	12	27-Mar-2015
Termination (50ohm)	Diamond Antenna	DL-30N	3102	12	8-Oct-2015
8 Channel Datalogger + Terminal Board	Pico Technology Ltd	ADC-16	3287	12	12-Dec-2015
Resistor (Nominal 0.25ohm)	TUV SUD Product Service	2x RS Components 188-071 R5/100W Resistors	3343	12	24-Oct-2015
Section 2.1, 2.2, 2.4, 2.5 Beacons - Constant Temperature Tests					
Climatic Chamber	Heraeus Votsch	VMT 04/30	40	-	O/P Mon
Power Meter	Hewlett Packard	436A	83	12	29-Aug-2015
Signal Generator	Hewlett Packard	8644A	96	12	23-Apr-2015
Termination (50ohm)	Diamond Antenna	DL-30N	219	12	3-Nov-2015
Distress Beacon RF Unit	TUV SUD Product Service	-	2445	-	TU
Hygromer	Rotronic	I-1000	2829	12	27-Oct-2015
Attenuator (20dB, 10W)	Aeroflex / Weinschel	23-20-34	3159	12	4-Jun-2015
Attenuator (3dB, 20W)	Aeroflex / Weinschel	23-03-34	3163	12	16-Sep-2015
Bandpass Filter	Trilithic	5BE406/35-1-AA	3205	12	17-Sep-2015
Time Interval Analyser	Yokogawa	TA720 704510	3253	12	11-Nov-2015
ScopeCorder	Yokogawa	DL750 701210	3254	12	10-Nov-2015
RF Short Circuit	TUV SUD Product Service	Short Circuit	3268	-	TU
Power Sensor	Agilent Technologies	8482A	3290	12	16-Jan-2016
ESA-E Series Spectrum Analyser	Agilent Technologies	E4402B	3348	12	5-Sep-2015
Cable (1m, N Type)	Rhophase	NPS-1601-1000-NPS	3351	12	29-Apr-2015
Cable (2m, N Type)	Rhophase	NPS-1601-2000-NPS	3356	12	3-Dec-2015
Rubidium Frequency Standard	Symmetricom	8040C	3490	12	31-Mar-2015
1 metre SMA Cable	Florida Labs	SMS-235SP-39.4-SMS	4512	12	29-Jan-2016

Instrument	Manufacturer	Type No.	TE No.	Calibration Period (months)	Calibration Due
Section 2.11 Beacons - Navigation System					
Antenna (Double Ridge Guide)	EMCO	3115	34	12	28-Nov-2015
Attenuator: 10dB/20W	Narda	766-10	480	12	3-Dec-2015
Spectrum Analyser	Agilent Technologies	E4407B	1154	12	21-Aug-2015
Screened Room (8)	Rainford	Rainford	1548	-	TU
Hygrometer	Rotronic	I-1000	2882	12	27-Oct-2015
Beacon Tester	WS Technologies	BT100S	3263	-	TU
Signal Generator: 10MHz to 20GHz	Rohde & Schwarz	SMR20	3475	12	18-Feb-2016
P-Series Power Meter	Agilent Technologies	N1911A	3981	12	22-Sep-2015
50 MHz-18 GHz Wideband Power Sensor	Agilent Technologies	N1921A	3983	12	22-Sep-2015
1 Metre SMA Cable	Rhophase	3PS-1801A-1000-3PS	4100	12	3-Jun-2015
0.92 to 2.2 GHz Coupler	Narda	3042B	4472	12	5-Dec-2015
Section 2.7 Beacons - Operating Lifetime					
Climatic Chamber	Heraeus Votsch	VMT 04/30	40	-	O/P Mon
Power Meter	Hewlett Packard	436A	83	12	29-Aug-2015
Signal Generator	Hewlett Packard	8644A	96	12	23-Apr-2015
Spectrum Analyser	Agilent Technologies	E4407B	1154	12	21-Aug-2015
Distress Beacon RF Unit	TUV SUD Product Service	-	2445	-	TU
Hygromer	Rotronic	I-1000	2829	12	27-Oct-2015
Termination (50ohm, 2W)	Omni-Spectra	3001-6100	3081	12	27-Mar-2015
Attenuator (20dB, 10W)	Aeroflex / Weinschel	23-20-34	3158	12	30-Jun-2015
Attenuator (20dB, 10W)	Aeroflex / Weinschel	23-20-34	3159	12	4-Jun-2015
Attenuator (3dB, 20W)	Aeroflex / Weinschel	23-03-34	3163	12	16-Sep-2015
Thermocouple Thermometer	Fluke	51	3172	12	24-Sep-2015
Bandpass Filter	Trilithic	5BE406/35-1-AA	3205	12	17-Sep-2015
Time Interval Analyser	Yokogawa	TA720 704510	3253	12	11-Nov-2015
ScopeCorder	Yokogawa	DL750 701210	3254	12	10-Nov-2015
Power Sensor	Agilent Technologies	8482A	3290	12	16-Jan-2016
Rubidium Frequency Standard	Symmetricom	8040C	3490	12	31-Mar-2015
1 metre SMA Cable	Florida Labs	SMS-235SP-39.4-SMS	4512	12	29-Jan-2016

Instrument	Manufacturer	Type No.	TE No.	Calibration Period (months)	Calibration Due
Section 2.3 Beacons - Spurious Emissions					
Climatic Chamber	Heraeus Votsch	VM 04/100	85	-	O/P Mon
Hygromer	Rotronic	I-1000	2829	12	27-Oct-2015
Attenuator (20dB, 10W)	Aeroflex / Weinschel	23-20-34	3158	12	30-Jun-2015
ESA-E Series Spectrum Analyser	Agilent Technologies	E4402B	3348	12	5-Sep-2015
Rubidium Frequency Standard	Symmetricom	8040C	3490	12	31-Mar-2015
2 metre SMA Cable	Florida Labs	SMS-235SP-78.8-SMS	4517	12	29-Jan-2016
Section 2.8 Beacons - Temperature Gradient Combined					
Power Meter	Hewlett Packard	436A	83	12	29-Aug-2015
Climatic Chamber	Heraeus Votsch	VM 04/100	85	-	O/P Mon
Signal Generator	Hewlett Packard	8644A	96	12	23-Apr-2015
Distress Beacon RF Unit	TUV SUD Product Service	-	2445	-	TU
Hygromer	Rotronic	I-1000	2829	12	27-Oct-2015
Termination (50ohm, 2W)	Omni-Spectra	3001-6100	3081	12	27-Mar-2015
Attenuator (20dB, 10W)	Aeroflex / Weinschel	23-20-34	3159	12	4-Jun-2015
Attenuator (3dB, 20W)	Aeroflex / Weinschel	23-03-34	3163	12	16-Sep-2015
Thermocouple Thermometer	Fluke	51	3172	12	24-Sep-2015
Bandpass Filter	Trilithic	5BE406/35-1-AA	3205	12	17-Sep-2015
Time Interval Analyser	Yokogawa	TA720 704510	3253	12	11-Nov-2015
ScopeCorder	Yokogawa	DL750 701210	3254	12	10-Nov-2015
Power Sensor	Agilent Technologies	8482A	3290	12	16-Jan-2016
Rubidium Frequency Standard	Symmetricom	8040C	3490	12	31-Mar-2015
1 metre SMA Cable	Florida Labs	SMS-235SP-39.4-SMS	4512	12	29-Jan-2016
2 metre SMA Cable	Florida Labs	SMS-235SP-78.8-SMS	4517	12	29-Jan-2016
2 metre SMA Cable	Florida Labs	SMS-235SP-78.8-SMS	4518	12	29-Jan-2016

Instrument	Manufacturer	Type No.	TE No.	Calibration Period (months)	Calibration Due
Section 2.6 Beacons - Thermal Shock					
Climatic Chamber	Heraeus Votsch	VMT 04/30	40	-	O/P Mon
Power Meter	Hewlett Packard	436A	83	12	29-Aug-2015
Climatic Chamber	Heraeus Votsch	VM 04/100	85	-	O/P Mon
Signal Generator	Hewlett Packard	8644A	96	12	23-Apr-2015
Distress Beacon RF Unit	TUV SUD Product Service	-	2445	-	TU
Hygromer	Rotronic	I-1000	2829	12	27-Oct-2015
Termination (50ohm, 2W)	Omni-Spectra	3001-6100	3081	12	27-Mar-2015
Attenuator (20dB, 10W)	Aeroflex / Weinschel	23-20-34	3159	12	4-Jun-2015
Attenuator (3dB, 20W)	Aeroflex / Weinschel	23-03-34	3163	12	16-Sep-2015
Thermocouple Thermometer	Fluke	51	3172	12	24-Sep-2015
Bandpass Filter	Trilithic	5BE406/35-1-AA	3205	12	17-Sep-2015
Time Interval Analyser	Yokogawa	TA720 704510	3253	12	11-Nov-2015
ScopeCorder	Yokogawa	DL750 701210	3254	12	10-Nov-2015
Power Sensor	Agilent Technologies	8482A	3290	12	16-Jan-2016
Cable (1m, N Type)	Rhophase	NPS-1601-1000-NPS	3351	12	29-Apr-2015
Rubidium Frequency Standard	Symmetricom	8040C	3490	12	31-Mar-2015
1 metre SMA Cable	Florida Labs	SMS-235SP-39.4-SMS	4512	12	29-Jan-2016

TU – Traceability Unscheduled
OP MON – Output Monitored with Calibrated Equipment

Product Service

SECTION 4

PHOTOGRAPHS

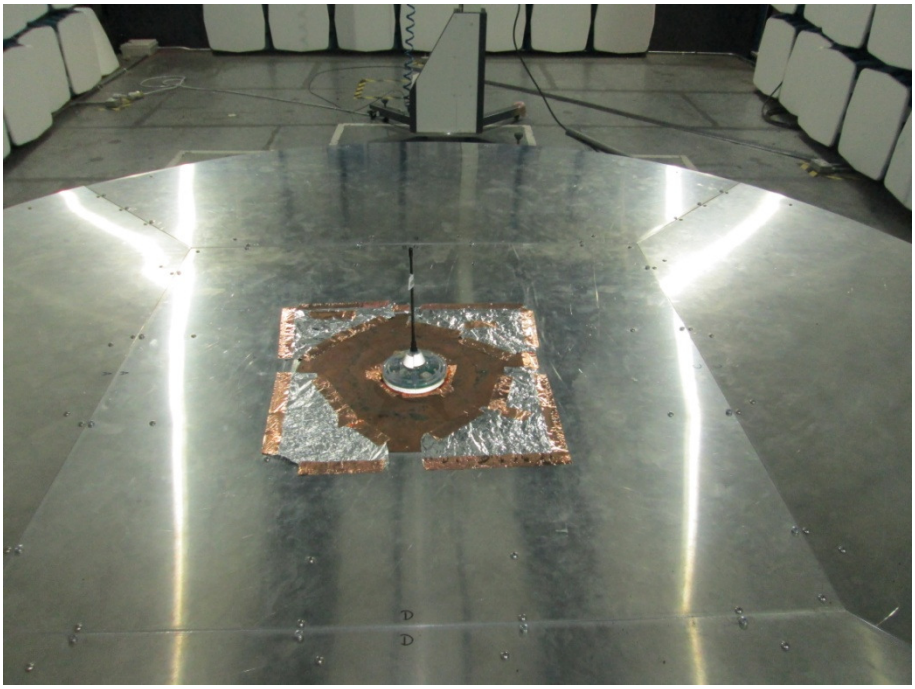
4.1 PHOTOGRAPHS OF EQUIPMENT UNDER TEST (EUT)

Front View

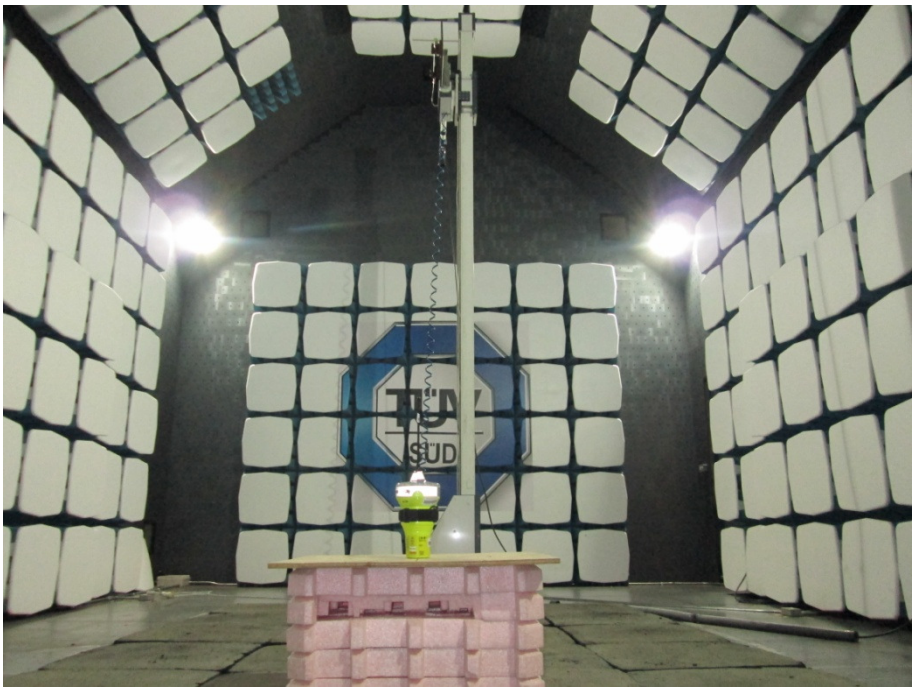
Conducted Sample

EUT and Manual Release Bracket

EUT and Float Free Case



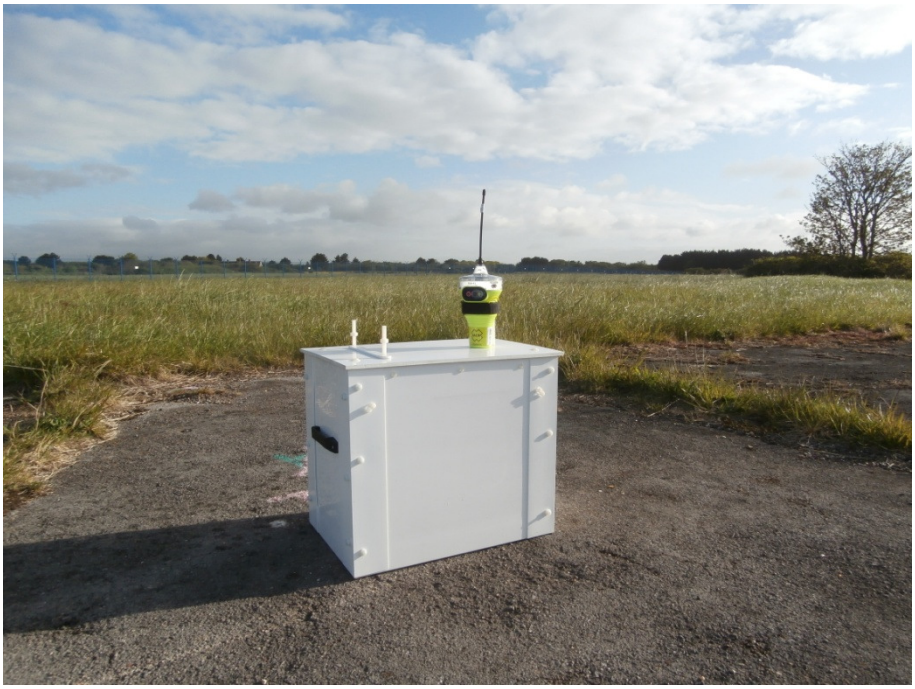
Antenna Test - Configuration 1



Antenna Test - Configuration 4

Satellite Qualitative - Configuration 5

Satellite Qualitative - Configuration 7



Satellite Qualitative - Configuration 8

General Setup - Conducted Lab tests

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

CUSTOMER SUPPLIED INFORMATION

ACR EPIRB Models:
RLB-41:
Description of Modes of Operation

Per C/S T.007 5(d)

Off Mode:

The microcontroller is not powered during off mode. There is no microprocessor activity and no power consumption by the microcontroller.

Self-Test Mode:

Self-test is initiated by momentarily pushing the self-test button and holding it for at least 1 second and at most 4 seconds. The green LED will flash briefly to indicate that the button should be released so the self-test can begin.

During self-test the following occurs:

- Battery Life Test:
  - Total time the beacon has been on is checked and
  - The number of emergency activations is checked to see if an emergency activation has occurred and
  - The number of read-write errors to the battery pack memory is checked and if it has increased since last self-test an error is reported
  - The serial number in the battery pack is validated.
- RF Test:
  - One 406 MHz self-test message is transmitted with default location data and
    - PLL lock detect is checked and
    - 406 MHz RF power is checked
  - 121.5 MHz sweeps are transmitted for 1 second and
    - 121.5 MHz RF power is checked
  - NOTE: A green flash of the RF Test P/F Indicator is a distinct indication that 406 MHz and 121.5 MHz RF power emitted.

- Board Test:
  - Nonvolatile memory is checked and
  - Internal GPS module is checked by looking for incoming data with 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 and the total ON time is saved in nonvolatile memory on the battery board.

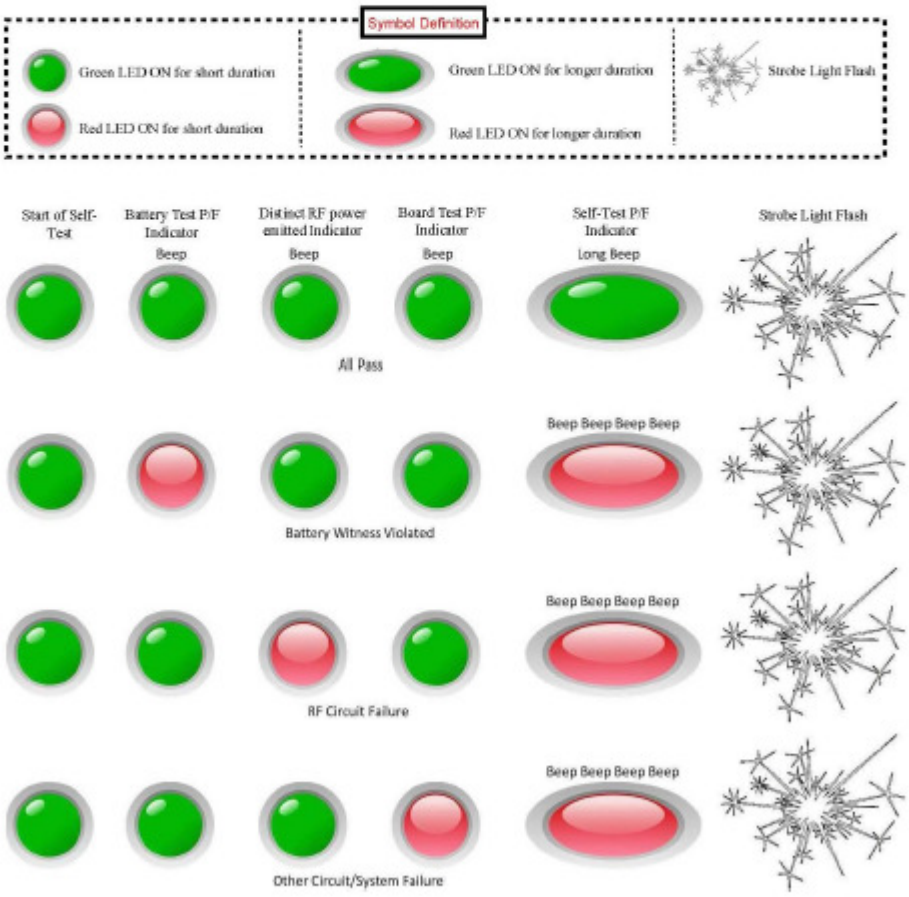
As each individual test (Battery Life Test, RF Test, and Board Test) passes a green LED flashes and the buzzer beeps once. If an individual test fails a red LED flashes and the buzzer beeps once.

If all individual tests pass, then self-test passes and the green LED turns on for three (3) seconds and the buzzer beeps for one (1) second at the completion of self-test.

If any individual test fails self-test fails, the red LED turns on for three (3) seconds and the buzzer beeps four (4) times at the completion of self-test.

The strobe light is then flashed to show that the strobe light is working.

The following describes the audio visual feedback the beacon provides during self-test:



When self-test is complete, including the display of the self-test results, the beacon turns off.

If the activation button is pressed during the self-test, the beacon will be activated and enter normal operating mode.

Self-test takes approximately 11 seconds to run if all the tests pass; if there is a failure in the GPS module, the self-test can run for approximately 14 seconds.

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 190 minutes, the beacon fails the battery test; additional self-tests can continue to be run after the total ON time exceeds 190 minutes.

GNSS Self-Test Mode

The GNSS self-test tests the internal GPS module.

A GNSS self-test is initiated by pressing the self-test button and holding it for greater than 5 seconds. This will start the long GNSS self-test procedure if the number of allowed GNSS self-tests run has not been attained.

The beacon will turn off after the GNSS self-test is finished unless the activation button is pressed or the beacon is immersed in water. In this case the beacon will immediately enter activation mode.

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

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

At the end of the GNSS self-test a 406 MHz transmission is made. The complete GNSS self-test 406 MHz transmission is limited to one burst only of 520 milliseconds. The transmitted 406 message has a 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.

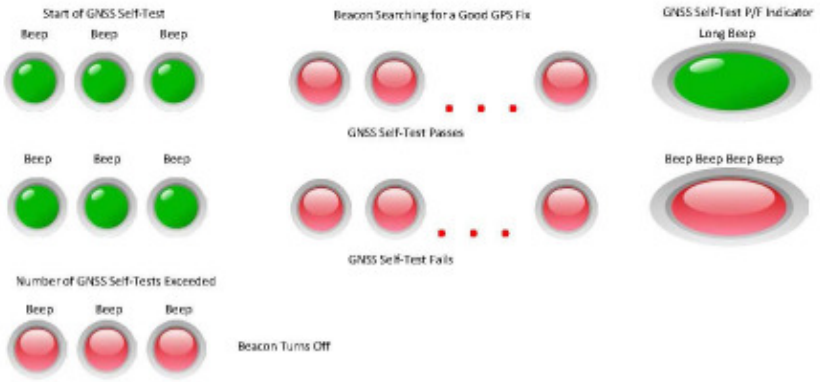
If the beacon is able to acquire a valid GPS position before the two minute time limit, the GNSS self-test passes and the beacon will flash the green LED for three (3) seconds and will beep for one (1) second.

If the beacon is unable to acquire a valid GPS position in two minutes the GNSS self-test stops and the test fails; the beacon will flash the red LED for three (3) seconds and will beep four (4) times.

Once 84 GNSS self-tests have been completed, if an attempt is made to run a GNSS self-test, the unit will flash the red LED three (3) times and beep three times. 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.

The following describes the audio visual feedback the beacon provides during GNSS self-test:



Main Operating Mode:

The main operating mode is entered by pressing the activation button for at least two (2) seconds. After the beacon has entered normal operating mode if the activation button is pressed for at least three (3) seconds, the normal beacon operation will stop and the beacon will turn off.

The LED flashes red and the buzzer beeps after the activation button has been pressed for two (2) seconds indicating that the beacon has been activated. The LED then flashes red or green at a rate of 20 per second until the beacon is turned off or battery end-of-life. Red LED flashes indicate that valid GPS location has not been found or that 4 hours have passed without a valid GPS location update; green LED flashes indicate that a valid GPS location has been found.

Note: A good GPS fix means that a good GPS location has been acquired by the beacon.

The white LED strobe light flashes at a rate of 20 per minute until the beacon is turned off or battery end-of-life.

The first 406 MHz burst is transmitted 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. The beacon beeps after each 406 MHz transmission.

121.5 MHz transmissions begin immediately after the first 406 MHz burst. The 121.5 MHz transmissions continue until 1.4 seconds before the next 406 MHz burst is due to begin. This cycle continues with 121.5 MHz transmissions ending 1.4 seconds before the next scheduled 406 MHz burst.

The time between 406 MHz bursts is determined by a random number generator and is between 47.5 seconds and 52.5 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 NMEA sentence header is checked to ensure the sentence is parsed correctly, the basic NMEA sentence structure and checksum must be correct, the number of satellites must be 3 or more, the HDOP must be four (4) or less, the quality factor must be GPS SPS Mode, fix valid, differential GPS SPS Mode, fix valid, or GPS PPS Mode, fix valid, and the latitude and longitude must be valid locations.

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 turns off if the activation button is pressed for at least three (3) seconds.

GPS On/Off Cycle:

The following schedule is followed until an initial valid GPS location is encoded into the beacon message:

- For the first 60 minutes, the GPS is turned on for 10 minutes once every 20 minutes.
- For the next 60 minutes, the GPS is turned on for 5 minutes once every 15 minutes.

If a valid location fix is obtained during either of the above GPS on times, the GPS is turned off immediately. The GPS is then turned on no less than 25 minutes and no more than 30 minutes from the time the GPS was previously turned on, then the GPS is then turned on and off according to the schedule below. If no valid fix was obtained during the above schedule, the schedule below is followed.

- For the next 6 hours the GPS is turned on once every 30 minutes and is on for a period of 5 minutes or until a valid location fix is obtained.
- For the next 18 hours the GPS is turned on once every 2 hours and is on for a period of 5 minutes or until a valid location fix is obtained.
- Until the battery end-of-life, the GPS is turned on once every 4 hours and is on for a period of 5 minutes or until a valid location fix is obtained.

Statements and Descriptions for

ACR RLB-41 GlobalFix ™ V4 Beacon

COSPAS-SARSAT Application

Protection against Continuous Transmission for RLB-41 (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:
RLB-41 is designed to limit any inadvertent 406MHz transmission:

The 406_on signal enable the Dc bias for 406 MHz power amplifier Q800 and Q802 making power amplifier operational. The 406_on signal also supply voltage to the gate Q801 thru R807, R812 and C818 with time constant 2.2sec if power amplifier is on longer than 2.2sec sufficed voltage will developed on C818 to turn Q801 on this will result that gate of Q403 will be connected to ground and therefore disabling conduction of the Q800 and Q802. Without the DC bias voltage on Q800 and Q802 the 406 MHz transmitter will be disabled.

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 stuck 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, and sounds the buzzer. Nothing else can be generated when in this mode. Therefore, if the switch is left in the self-test position, it is not possible to generate more than one self-test.

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 ($GPGGA), the quality indicator, the NMEA checksum, number of satellites, HDOP and position data. Specifically, the predetermined header data must be verified and the GPS Quality Indicator must be GPS SPS Mode, fix valid, differential GPS SPS Mode, fix valid, or GPS PPS Mode, fix valid; the number of satellites in-range must be three (3) or more and the HDOP must be four (4) or less; the longitude and latitude values must both be valid locations. 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 is not changed. Therefore, it is not possible for 406

MHz transmissions to be degraded by a malfunctioning GPS or the failure of the GPS to acquire correct data.

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.

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 ($GPGGA), the quality indicator, the NMEA checksum, number of satellites, HDOP and position data. Specifically, the predetermined header data must be verified and the GPS Quality Indicator must be

GNSS Self-Test Mode

The GNSS self-test tests the internal GPS module. A GNSS self-test is initiated by moving the three-position switch to the middle (upright position) and holding it for greater than 5 seconds. This will start the long GNSS self-test procedure if the number of allowed GNSS self-tests run has not been attained.

Either holding the three-position switch in the middle (upright position) or moving the 3-position switch to the off position during the GNSS self-test, will cause the beacon to turn off after the GNSS self-test is finished.

Moving the 3-position switch to the on position during GNSS self-test causes the beacon to immediately enter activation mode.

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

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

At the end of the GNSS self-test a 406 MHz transmission is made. The complete GNSS self-test 406 MHz transmission is limited to one burst only of 520 milliseconds. The transmitted 406 message has a 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 two minute time limit, the GNSS self-test passes and the beacon will flash the green LED for three (3) seconds and will beep for one (1) second.

If the beacon is unable to acquire a valid GPS position in two minutes the GNSS self-test stops and the test fails; the beacon will flash the red LED for three (3) seconds and will beep four (4) times.

Once 84 GNSS self-tests have been completed, if an attempt is made to run a GNSS self-test, the unit will flash the red LED three (3) times and beep three times. 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.here was no GPS data present.

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Report on: Beacon Coding Software (BCS) and Position Data Encoding (PDE) of the ACR Electronics, Inc. RLB-41

Document Number: Y1-13-0208

Revision: A

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REPORT ON Emergency Beacons Testing of the
ACR Electronics, Inc.
RLB-41
Document Y1-13-0208 Revision A
7/7/2015

PREPARED AND APPROVED BY

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DATED 7/7/2015

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SECTION 1

REPORT SUMMARY

**Emergency Beacons Testing of the
ACR Electronics, Inc
RLB-41**

1.1 INTRODUCTION

The information contained in this report is intended to show verification of the Emergency Beacon Testing of the ACR Electronics, Inc RLB-41 to the requirements of T.007 Issue 4 – Rev 9 October 2014.

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 4 - Rev 9 October 2014
Manufacturer	ACR Electronics, Inc
Beacon Model Number(s)	RLB-41
RLB-41 Assembly Model Part Number	A3-06-2862, Rev A
RLB-41 Firmware Part Number and Version	K3-01-0122, Rev B
Number of Samples Tested	One
Test Specification/Issue/Date	Cospas-Sarsat T.007 Issue 4 – Rev 9 October 2014
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	12/06/2014
Finish of Test	12/09/2014
Performed by	Qingchuan Yao, Alan Dorundo
Verified by	Alan Dorundo, Celia Miguez, Dan Stankovic

1.2 BEACON MANUFACTURER AND BEACON MODEL

Beacon Manufacturer	ACR Electronics, Inc.
Beacon Model	RLB-41
Other Model Names	GlobalFix™ V4

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	3	15
C/S T.007	4	9

1.3 REFERENCES

1.3.1 External Documents

[1] Introduction to the COSPAS-SARSAT System, C/S G.003 (Issue 6 – October 2009)

[2] Specification for COSPAS-SARSAT 406 MHz Distress Beacons, C/S T.001 (Issue 3 – Revision 15, October 2014)

[3] COSPAS-SARSAT 406 MHz Distress Beacon Type Approval Standard, C/S T.007 (Issue 4 - Revision 9, October 2014)

[4] COSPAS-SARSAT 406 MHz Frequency Management Plan C/S T.012 (Issue 1 – Revision 8 October 2012)

1.3.2 Internal Documents

[1] Y1-10-0110, "RLB-41/42/4x EPIRB Software Requirements Specification, ACR Electronics, Inc."

[2] Y1-10-0112, "RLB-41/42/4x EPIRB Software Test Plan, ACR Electronics, Inc."

[3] Y1-10-0113, "RLB-41/42/4x EPIRB Software Requirements Traceability Matrix, ACR Electronics, Inc."

[4] Y1-10-0112-41, "RLB-41 EPIRB Software Test Results, ACR Electronics, Inc."

[5] Y1-10-0113-41, "RLB-41 EPIRB Software Requirements Traceability Matrix Results, ACR Electronics, Inc."

1.4 PRODUCT INFORMATION

1.4.1 Technical Description

The Equipment Under Test (EUT) was a ACR Electronics, Inc RLB-41 as shown in the photograph below. A full technical description can be found in the manufacturer's documentation.

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-30 application software will be used for beacon communications including beacon serialization.

Figure 1. RLB-41

1.5 REPORT MODIFICATION RECORD

Revision A- First Issue on 7/7/2015.

SECTION 2

TEST DETAILS

**Emergency Beacons Testing of the
ACR Electronics, Inc
RLB-41**

TEST RESULTS TABLE

Parameters to be Measured	Range of Specification	Units	Test Results:	Comments
16. Beacon Coding Software				
Model: RLB-41, Modification State 0				
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: RLB-41, Modification State 0				
Position Data Encoding	Correct	P / F	P	Test data in Section 2.2

2.1 BEACON CODING SOFTWARE

2.1.1 Equipment Under Test

RLB-41, Serial Number 24

2.1.2 Date of Test and Modification State

Modification State 0 (RLB-41)
Test Start: 12/09/2014
Test End: 12/09/2014

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. RLB-41

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: 80.168888° West	Lat: 26.226666° North Lon: 80.188888° West		Lat: 26.051111° North Lon: 80.168888° West
Standard Location: EPIRB with MMSI	FFFE2F8C92F423F01A2 A0B81CCF78C44DA11	FFFE2F8C92F423F01A 6A0A615E370583A49B	FFFED08C92F423F 07FDFFB2BF037	FFFED08C92F423F01A2 A0B81CCF78C44DA11
Standard Location: EPIRB with Serial Number	FFFE2F8C96F9C0631A2 A0938D3F78C44DA11	FFFE2F8C96F9C0631A 6A08D841370583A49B	FFFED08C96F9C0 637FDFF992EF37	FFFED08C96F9C0631A2 A0938D3F78C44DA11
National Location: EPIRB	FFFE2F8C9A704646855 028E149B71D080674	FFFE2F8C9A7046468F 5034981C770C2809C3	FFFED08C9A7046 5FC0FF07A3F437	FFFED08C9A704646855 028E149B71D080674

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

2 RLS protocols will be effective as of 1 November 2015. The use of RLS-enabled beacons will be regulated by national administrations. Since the RLS functionality might affect the 406 MHz beacon performance, amendments to the type approval procedure for these beacons could be required. Beacon manufacturers should consult the Cospas-Sarsat Secretariat before undertaking the type approval of RLS-enabled beacon models.

ACR Electronics, Inc. RLB-41

C/S T.007 Table F-D.3: Examples of User-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: 80.168888° West	Lat: 26.226666° North Lon: 80.188888° West		Lat: 26.051111° North Lon: 80.168888° West
Maritime Protocol with MMSI	FFFE2FCC94186186186689DE52A343503D2E	FFFE2FCC94186186186689DE52A3475038D0	FFFED0CC94186186186689DE52AF	FFFED0CC94186186186689DE52A343503D2E
Maritime Protocol with Radio Call Sign	FFFE2FCC9526F6F06B268F9F322343503D2E	FFFE2FCC9526F6F06B268F9F3223475038D0	FFFED0CC9526F6F06B268F9F322F	FFFED0CC9526F6F06B268F9F322343503D2E
Radio Call Sign	FFFE2FCC9DBDBC1A55468ED9F62343503D2E	FFFE2FCC9DBDBC1A55468ED9F623475038D0	FFFED0CC9DBDBC1A55468ED9F62F	FFFED0CC9DBDBC1A55468ED9F62343503D2E
Serial User-Location: Float-Free EPIRB	FFFE2FCC96A000C6007CEEBD42E343503D2E	FFFE2FCC96A000C6007CEEBD42E3475038D0	FFFED0CC96A000C6007CEEBD42EF	FFFED0CC96A000C6007CEEBD42E343503D2E
Serial User-Location: Non Float-Free EPIRB	FFFE2FCC972000C6007CEB7FB16343503D2E	FFFE2FCC972000C6007CEB7FB163475038D0	FFFED0CC972000C6007CEB7FB16F	FFFED0CC972000C6007CEB7FB16343503D2E

1 Location "A" and location "B" must be separated by at least 10 km for the User-Location protocol.

2.2 NAVIGATION SYSTEM

2.2.1 Equipment Under Test

RLB-41

2.2.2 Date of Test and Modification State

Modification State 0 (RLB-41)

EUT system configuration during the test, including antenna, external ancillary devices, and modes of their operation.	The RLB-41 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 TeraTerm script and PC serial port.

Test Start: 12/06/2014
Test End: 12/09/2014

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

APPENDIX C TO ANNEX F
NAVIGATION SYSTEM TEST RESULTS
ACR Electronics, Inc. RLB-41, Internal GPS, GPGGA

C/S T.007 Table F-C.1: Position Data Encoding Results User-Location Protocol

Script Reference (Table D.1 C/S T.007 - Issue 4 - Revision 9 October 2014)	Value of Encoded Location Bits Transmitted by Beacon	Confirmation that BCH is Correct (√)
1	Bits 108-132= 0FE0FF0	√
2	Bits 108 – 132= 1001000 Number of seconds after providing navigation data that beacon transmitted the above encoded location information: 41 seconds	√
3	Bits 108-132= 0000000	√
4	Bits 108-132= 0006B3C	√
5	Bits 108-132= 1007B3C	√
6	Bits 108-132= 1B28590	√
7	Bits 108-132= 1B29590	√
8	Bits 108-132= 0B41B40	√
9	Bits 108-132= 0B3CB40	√
10	Bits 108-132= 14918A7	√
Self-Test Navigation Test Scripts		
11	Bits 108-132= 0F00000 (all zeroes for Bits 113 – 132)	√
12	Bits 108-132= 0F00000 (all zeroes for Bits 113 – 132)	√

ACR Electronics, Inc. RLB-41, Internal GPS, GPGGA

C/S T.007 Table F-C.2: Position Data Encoding Results Standard Location Protocol

Script Reference (Table D.2 C/S T.007 - Issue 4 - Revision 9 October 2014)	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: 43 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 = 00000 (all zeroes for Bits 113 – 132)	√
13	Bits 65 - 85 = 0FFBFF Bits 113 - 132 = 00000 (all zeroes for Bits 113 – 132)	√

ACR Electronics, Inc. RLB-41, Internal GPS, GPGGA

C/S T.007 Table F-C.3: Position Data Encoding Results National Location Protocol

Script Reference (See Table D.3 C/S T.007 - Issue 4 - Revision 9 October 2014)	Value of Encoded Location Bits Transmitted by Beacon	Confirmation that BCH is Correct (V)
1	Bits 59 - 85 = 3F81FE0 Bits 113 - 126 = 27CF	V
2	Bits 59 - 85 = 4002000 Bits 113 - 126 = 284E Number of seconds after providing navigation data that beacon transmitted the above encoded location information: 43 seconds	V
3	Bits 59 - 85 = 0000000 Bits 113 - 126 = 26CD	V
4	Bits 59 - 85 = 0019678 Bits 113 - 126 = 060D	V
5	Bits 59 - 85 = 001567A Bits 113 - 126 = 2710	V
6	Bits 59 - 85 = 401B677 Bits 113 - 126 = 0740	V
7	Bits 59 - 85 = 6CA0B20 Bits 113 - 126 = 06C0	V
8	Bits 59 - 85 = 6CA2B20 Bits 113 - 126 = 21C0	V
9	Bits 59 - 85 = 2D03680 Bits 113 - 126 = 0701	V
10	Bits 59 - 85 = 2CF5680 Bits 113 - 126 = 2009	V
11	Bits 59 - 85 = 523F14F Bits 113 - 126 = 2040	V
Self-Test Navigation Test Scripts		
12	Bits 59 - 85 = 3F81FE0 Bits 113 - 126 = 0000 (all zeroes for Bits 113 – 126)	V
13	Bits 59 - 85 = 3F81FE0 Bits 113 - 126 = 0000 (all zeroes for Bits 113 – 126)	V

2.3 TEST EQUIPMENT USED

	Description	ACR P/N
Hardware	PC-compatible	Purchased Commercial Hardware
Operating System	Windows XP SP3 / Windows 7	
Flash Device	Texas Instruments MSP-FET430UIF OR Elprotronic FlashPro430	Purchased Commercial Hardware
Software Verification and Validation Environment and Equipment	• PC	Purchased Commercial Hardware
	• Windows XP SP3 / Windows 7	N/A
	• RLB-41 Assembly	A3-06-2862, Rev A
	• RLB-41 Firmware	K3-01-0122, Rev B
	• TI Code Composer v4.34	K1-02-0027
	• TeraTerm V4.71or better	K1-02-0047
	• USB Cable	A3-06-2599
	• FPR-300 ACR Electronics Field Programmer/Reader v1.12.14 or other (406 message decoder)	A3-06-2619
	• FPR-30 v1.12.14	A3-06-2596
	• Power Supply	Purchased Commercial Hardware
	• TeraTerm Navigation Scripts	
	• Java Automation Scripts	

ACR RLB-41

Manufacturer Declared

Table F-E.1: Beacon Operating Current

Beacon Operating Modes	Mode: Manually selectable or Automatic	Measurement interval, sec	Average Current, mA	Peak Current, mA
Standalone - Standby	Automatic	1800	0.00007	0.00013
Manual release bracket - Standby	Automatic	1800	0.00005	0.00006
Automatic release bracket - Standby	Manual	1800	0.00005	0.00006
Standalone - On at switch, GPS search	Manual*	1800	42.59	1556.00
Manual release bracket - On at switch, GPS search	Manual*	1800	42.46	1575.00
Automatic release bracket - On at switch, GPS search	Manual*	1800	41.63	1536.00
Standalone - On at Water Contacts, GPS search	Automatic*	1800	42.26	1573.00
Standalone - On at switch, GPS sleep	Manual*	550	34.31	1534.00
Manual release bracket - On at switch, GPS sleep	Manual*	550	33.20	1552.00
Automatic release bracket - On at switch, GPS sleep	Manual*	550	33.29	1506.00
Standalone - On at Water Contacts, GPS sleep	Automatic*	550	33.38	1552.00
Standalone - Self-test	Manual	11	80.26	1568.00
Manual release bracket - Self-test	Manual	11	74.78	1585.00
Automatic release bracket - Self-test	Manual	11	74.33	1514.00
Standalone - GNSS Self-test, timeout	Manual	132	28.26	1570.00
Manual release bracket - GNSS Self-test, timeout	Manual	132	28.60	1569.00
Automatic release bracket - GNSS Self-test, timeout	Manual	132	29.48	1522.00

* When activated, the ELT automatically switched from GPS sleep to GPS search.

All possible modes of operation for RLB-41 are listed in the table above. In each case the Measurement Interval was sufficient to cover all modes of operation of the beacon including transmission of 121 MHz homing signal and GPS acquisition active.

Based on current consumption measurements above, the following conclusions were made:

1 The standby mode that draws highest current of 0.00007 mA, was measured in Standalone - Standby Beacon Operating Mode.

2 The self-test mode that draws highest current of 80.26 mA, was measured in Standalone - Self-test Beacon Operating Mode.

3 The GNSS SELF-TEST mode that draws highest current of 29.48 mA, was measured in Automatic release bracket - GNSS Self-test, timeout Beacon Operating Mode.

4 The operating mode that draws highest current of 42.59 mA, was measured in Standalone - On at switch, GPS search Beacon Operating Mode.

ACR RLB-41

Manufacturer Declared

Table F-E.2: Pre-test Battery Discharge Calculations

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	Number of Years	0.25	
Declared beacon battery replacement period (from date of installation in the beacon to expiry date marked on the beacon)	T_{BR} or TBR	Number of Years	10	
Battery pack electrical configuration	Series			
Cell model and cell chemistry	CR123A. 2/3A, Chemistry LiMnO2			
Nominal cell capacity		A-hrs	4.200	
Nominal battery pack capacity	C_{BN}	A-hrs	4.200	
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}	A-hrs	0.4111	
Number of self-tests per year	N_{ST}		12	
Average battery current during a self-test	I_{ST}	mA	80.26	
Maximum duration of a self-test	T_{ST}	sec	30	
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}	mA-hrs	80.26	
Maximum Number of GNSS self-tests between battery replacements	N_{GST}		84	
Average battery current during a GNSS self-test of maximum duration	I_{GST}	mA	29.4758	
Maximum duration of a GNSS self-test	T_{GST}	sec	132	
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}	mA-hrs	90.7856	
Average stand-by battery pack current	I_{SB}	mA	0.000072960	
Other Capacity Losses	LOTH	mA-hrs	0	
Battery pack capacity loss due to constant operation of circuitry prior to beacon activation: $L_{ISB} = I_{SB} * T_{BR} * 8760$	L_{ISB}	mA-hrs	6.3913	
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}	A-hrs	0.7039	

Battery Preconditioning/Discharge time = Worst Case drain/operational current

Battery Preconditioning	0.7039	AmpHours
Operating Current obtained from Table F-E.1	0.0426	Amps
Battery Preconditioning/Discharge time	16.53	Hours