Product Service

Choose certainty.
Add value.

Report On

Emergency Beacons Testing of the
ACR Electronics Inc PLB-425
In accordance with Cospas-Sarsat T.007

Document 75943114 Report 01 Issue 6 **January 2019**

TÜV SÜD Product Service, Octagon House, Concorde Way, Segensworth North,
Fareham, Hampshire, United Kingdom, PO15 5RL
Tel: +44 (0) 1489 558100. Website: www.tuv-sud.co.uk

REPORT ON

Emergency Beacons Testing of the
ACR Electronics Inc
PLB-425

Document 75943114 Report 01 Issue 6

January 2019

PREPARED FOR

ACR Electronics Inc
5757 Ravenswood Road
Ft Lauderdale
USA

PREPARED BY

Martin Hardy
Engineer

APPROVED BY

Nic Forsyth
Authorised Signatory

DATED

24 January 2019

UKAS TESTING 0141

Product Service

CONTENTS

Product Service

SECTION 1

REPORT SUMMARY

Emergency Beacons Testing of the
ACR Electronics Inc
PLB-425

1.1 INTRODUCTION

The information contained in this report is intended to show verification of the ACR Electronics Inc PLB-425 to the requirements of Cospas-Sarsat T.007.

Objective	To perform Emergency Beacon Testing to determine the Equipment Under Test's (EUT's) compliance with the Test Specification, for the series of tests carried out.
Manufacturer	ACR Electronics Inc
Model Number(s)	PLB-425
Serial Number(s)	3 RTCM 7 C/S 15 11 C/S
Number of Samples Tested	4
Test Specification/Issue/Date	Cospas-Sarsat T.007 Issue 5 - Rev 2 June 2018
Date of Receipt of Test Samples	04 July 2018
Order Number Date	45902 25/06/2018
Start of Test	05 July 2018
Finish of Test	06 November 2018
Name of Engineer(s)	M Hardy N Grigsby
Related Documents	Cospas-Sarsat T.001 Issue 4 Revision 3 June 2018 Cospas-Sarsat T.IP (TCXO) Issue 1 Revision 5 October 2013

1.2 APPLICATION FORM

G.1 - Beacon Manufacturer and Beacon Model	
Beacon Manufacturer	ACR Electronics, Inc.
Beacon Manufacturer's Address	5757 Ravenswood Road
Beacon Model Name	PLB-400 and PLB-425
Additional Beacon Model Names	For PLB-400: ResQLink 400 For PLB-425: ResQLink View

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

G.1 - Beacon Characteristics		
Characteristic	Declared Value	
Operating frequency (406 MHz operating channel = 406.nnn)	406.031 MHz	
Operating temperature range	Tmin = -20 °C	Tmax= +55 °C
Temperature, at which minimum duration of continuous operation is expected (Submit C/S T.007 Section 5, part s, if applicable)	Tmin ☒	or Other (nn °C)
Operating lifetime	24	hours, or
	1440	minutes
Beacon power supply type (internal non-rechargeable, internal re-chargeable, external, combined, other)	Internal non -rechargeable	
External power supply parameters (AC/DC and nominal voltage)	N/A	
Is external power supply needed to energise the beacon or its ancillary devices in any of operational modes (N/A or Yes or No)	No	
Battery cell chemistry	LiMnO2	
Battery cell model name, cell size, number of cells in a battery pack, and details of the battery pack electrical configuration	Cell Model Name:	CR123A
	Cell Size:	2/3A
	Number of Cells in Battery Pack:	3
	Details of the battery pack electrical configuration:	Series
Battery cell manufacturer	Panasonic	
Battery pack manufacturer and part number	Battery Pack Manufacturer Name:	ACR Electronics, Inc.
	Battery Pack Part Number:	A3-06-2703
Beacon manufacturers declared maximum allowed cell shelf-life (from date of cell manufacture to date of battery pack installation in the beacon)	1	years
Declared beacon battery replacement period (from date of installation in the beacon to expiry date marked on the beacon)	5	years

Oscillator type (e.g. OCXO, MCXO, TCXO)	TCXO	
Oscillator manufacturer	RAKON (Made in New Zealand)	
Oscillator model name/ part number	Model Name:	TCXO
	Part Number:	RAKON P/N E6907LF, ACR P/N A1-11-1169
Oscillator satisfies long-term frequency stability requirements (Yes or No)	Yes	
Antenna type: Integral or Other (e.g. External, Detachable – specify type)	Integral	
Antenna manufacturer	ACR Electronics Inc.	
Antenna part name and part number (OEM, if applicable, and beacon manufacturer's)	OEM Model Name:	PLB-400 and PLB-425 Antenna
	OEM Part Number:	A3-06-3136
	Beacon Manufacturer's Model Name:	PLB-400 and PLB-425 Antenna
	Beacon Manufacturer's Part Number:	A3-06-3136
Antenna cable assembly min/max RF- losses at 406 MHz, if applicable	Minimum loss (dB):	N/A
	Maximum loss (dB):	N/A
Navigation device type (Internal, External or None)	Internal	
Features in beacon that prevent degradation to 406 MHz signal or beacon lifetime resulting from a failure of navigation device or failure to acquire position data (Yes, No, or N/A)	Yes	
Features in beacon that ensure erroneous position data is not encoded into the beacon message (Yes, No or N/A)	Yes	
Navigation device capable of supporting global coverage (Yes, No or N/A)	Yes	
Encoded position update capability (Yes, No, N/A) ~~and~~	Yes	
Encoded position update interval value (range)	5 to 60	minutes

For Internal Navigation Devices		
Geodetic reference system (WGS 84 or GTRF)	WGS 84	
GNSS receiver cold start forced at every beacon activation (Yes or No)	Yes	
Navigation device manufacturer	uBlox	
Navigation device model name and part Number	Model Name:	SAM-M8Q GPS module
	Part Number:	SAM-M8Q
Internal navigation device antenna type (integrated, internal, external, passive/active), manufacturer and model	Integral Ceramic to SAM-M8Q	
GNSS system supported (e.g. GPS, GLONASS, Galileo)	GPS	
For External Navigation Devices	N/A	
Data protocol for GNSS receiver to beacon interface	N/A	
Physical interface for beacon to navigation device	N/A	
Electrical interface for beacon to navigation device	N/A	
Part number of the external navigation interface device (if applicable)	N/A	
Navigation device model and manufacturer (if beacon designed to use specific devices)	N/A	

Self-Test Mode Characteristics:	Self-Test Mode	Optional GNSS Self-test Mode
Activated by a separate switch/ separate switch position (Yes or No)	Yes	Yes
Self-test/GNSS self-test mode switch automatically returns to normal position when released (Yes or No)	Yes	Yes
Self-test/ GNSS self-test activation can cause an operational mode transmission (Yes or No)	No	No
Results in transmission of a single self-test burst only, regardless of how long the self-test activation mechanism is applied (Yes or No)	Yes	Yes
Results of self-test / GNSS self-test are indicated by (provide details, e.g. Pass / Fail indicator light, strobe light, etc.)	Yes, Red Green LEDs. Additionally displayed on PLB-425	Yes, Red Green LEDs. Additionally displayed on PLB-425
The content of the encoded position data fields of the self-test message has default values	Yes	N/A
Performs an internal check and indicates that RF-power is being emitted at 406 MHz and 121.5 MHz, if beacon includes a 121.5 Hz homer (Yes or No)	Yes	Yes
Self-test results in transmission of a signal other than at 406 MHz (Yes & details or No)	Yes, 121.5 MHz	No
Self-test can be activated directly at beacon (Yes or No)	Yes	Yes
List of Items checked by self-test	Battery, 406 Pwr/PLL lock, 121 Pwr, Non-volatile memory Battery Witness Battery Voltage GPS Com Check	Battery, GPS ACQ, 406 Burst
Self-test/ GNSS self-test 406 MHz burst duration (440 or 520 ms)	440	520
Self-test message length format flag in bit 25, (“0” or “1”)	1	1
Maximum duration of a self-test mode, sec	14	110
Maximum recommended number of self-tests / GNSS self-tests during battery pack replacement period (as applicable)	60	20
Distinct indication of self-test start (Yes or No)	Yes	Yes

Indication of self-test results (Yes or No)	Yes	Yes
Distinct indication of insufficient battery capacity (Yes or No)	Yes	Yes
Automatic termination of self-test mode immediately after completion of the self-test cycle (Yes or No)	Yes	Yes
GNSS Self-test results in transmission of a single burst, irrespectively of the test result (Yes or No)	N/A	Yes
Self-test / GNSS self-test can be activated from beacon remote activation points (Yes & details or No)	No	No
List all methods of Self-test mode and GNSS Self-test modes activation. Provide details on a separate sheet to describe	Press Self-Test button 2 Sec to 5 Sec	Press Self-Test button for 5 Sec to 10 Sec

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

Other Declarations	Declared Value	
Beacon includes a homer transmitter(s) (Yes or No)	Yes	
- homer transmitter(s) frequency and power	Frequency	Power (dBm)
	121.5 MHz	17
	243.0 MHz	N/A
	AIS	N/A
	Other (MHz)	
	N/A	N/A
	Description:	N/A
homer transmitter(s) duty cycle	95	%
duty cycle of homer swept tone	33	%
Beacon includes a high intensity flashing light (e.g. Strobe)	Yes	
- light intensity	36.75 white light	cd
- flash rate	6	flashes per minute
Beacon transmission repetition period satisfies C/S T.001 requirement that two beacon's repetition periods are not synchronised closer than a few seconds over 5 minute period, and the time intervals between transmissions are randomly distributed on the interval 47.5 to 52.5 seconds (Yes or No)	Yes	
Other ancillary devices (e.g. voice transceiver, remote control, external audio and light indicators, external activation device). List details on a separate sheet if insufficient space to describe.	N/A	
Beacon includes automatic activation mechanism (Yes or No). Specify type of automatic beacon activation mechanism	Yes / No :	No
	Description:	N/A
Beacon includes features and functions not listed above, related or non-related to 406 MHz (Yes or No). List features and use a separate sheet if insufficient space	No	
	Description:	N/A
Beacon model hardware part number (P/N) and version	PLB-400: A3-06-3138-1 Rev T2 PLB-425: A3-06-3138- Rev T2	
Beacon model firmware P/N, version, date of issue/releases	K3-01-0145 Rev C	
Beacon model software P/N, version, date of issue/releases	K3-01-0145 Rev C	
Beacon model printed circuit board P/N and version	A3-07-0469 Rev C	
Known non-compliances with C/S T,001 requirements (Yes or No). If Yes, provide details (Submit C/S T.007 Section 5, part t, if applicable)	No	

Beacon Manufacturer Point of Contact (POC) for this Type Approval application:	
Name and Job Title:	Dan Stankovic, Director of Certification and Test
Phone:	954-862-2175
E-mail:	Dan.stankovic@acrartex.com
Dated(*)	05/29/2018
Signed(*)	Dan Stankovic, Director of Certification and Test 

Information Provided by the Cospas-Sarsat Accepted Test Facility

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

Date of Submission for Testing: 04 July 2018

Applicable C/S Standards:

Document	Issue	Revision	Date
C/S T.001	4	3	June 2018
C/S T.007	5	2	June 2018
IP (TCXO)	-	5	October 2013

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

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

Non-compliances:

Modulation – Phase Deviation (Maximum Positive at ambient and +55°C, and Maximum Negative at +55°C): outside the limits stated in C/S T.007. However, the results are within the Test Facility Accuracy figure stated in C/S T.008.

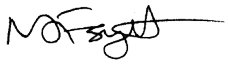
406MHz VSWR Check – Phase Deviation (Maximum Positive and Maximum Negative at +55°C): outside the limits stated in C/S T.007. However, the results are within the Test Facility Accuracy figure stated in C/S T.008.

Deviations:

Test results within this report have been presented in various Modification States of the EUT. The Modification State for each test has been recorded in the Summary Table and each Test Results section of the report.

Notes:

None.

Signed: 

Name: Nic Forsyth

Position Held: Authorised Signatory

Date: 24 January 2019

1.3 PRODUCT INFORMATION

1.3.1 Technical Description

The Equipment Under Test (EUT) was an ACR Electronics Inc PLB-425 as shown in the photograph below. A full technical description can be found in the manufacturer's documentation.

Equipment Under Test

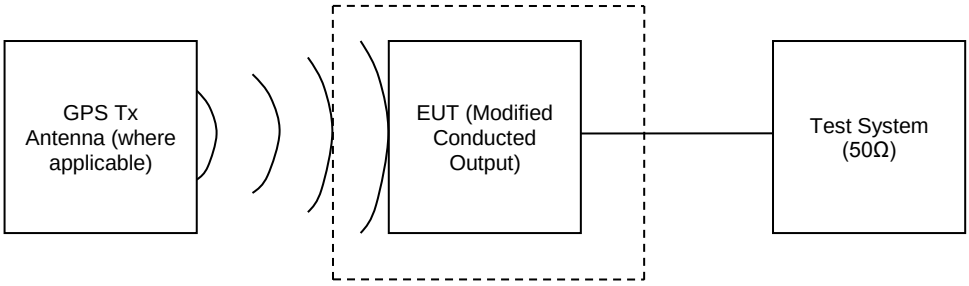
1.3.2 Physical Test Configuration

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 Acquisition Time and Position Accuracy.

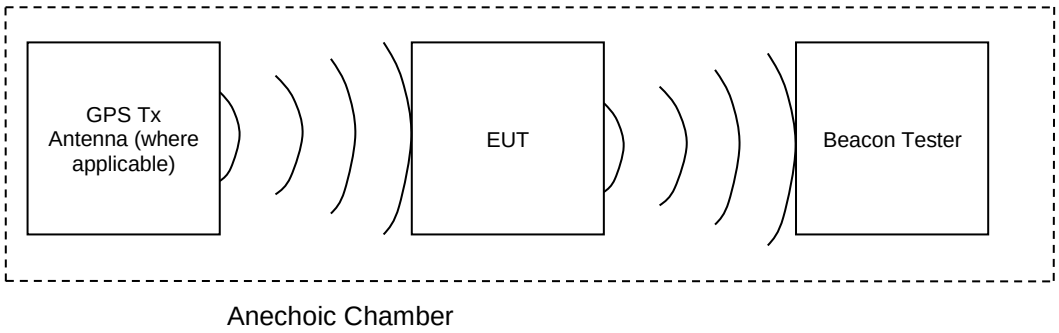
The second EUT was a fully packaged beacon, similar to the proposed production beacons equipped with its proper antenna. This EUT was used to perform Antenna Characteristics, Satellite Qualitative and Position Acquisition Time and Position Accuracy. The test configuration for these tests is a function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

System Configurations

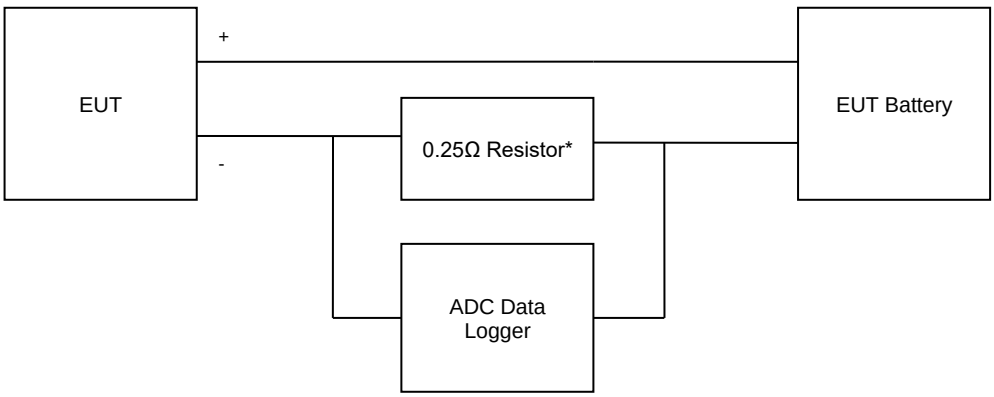
Conducted Laboratory Tests



A.3.8.3 Navigation Test



Battery Current Measurements



Note: The resistor is in series with the negative line of the battery

* Removed for Standby mode measurements
For other Navigation, Satellite and Antenna test configurations, see photographs in section 4 of this report.

Further Information

Battery current measurements (see ‘Operating lifetime’, section 2.9) concluded that the ‘worst case’ (highest current) operating mode of the EUT was TUV Ref: A4 – ON at EUT, GPS Search / GPS Off in normal operating duty cycle. All tests were carried out in this mode unless otherwise stated.

The EUT is fitted with a TCXO. The model and serial number of this oscillator used for this Type Approval is: Model: E6907, S/No: 599.

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

The EUT is fitted with a LCD. This is not under operator control and operates automatically when activated in normal or test mode. The manufacturer advised that the EUT LCD operated under worst case conductions during the testing.

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

1.3.3 Modes of Operation

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

Off/Standby Mode

- Main Activation button to OFF position

Self-test

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

GNSS Self-test

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

Programming Mode

- Hold “TEST” button for >15 and <20 seconds until LCD displays message ‘Programme Mode’

Operating

- Hold Main activation button until LCD displays ‘GPS – Acquiring position’
- 121 Homer active and offset to 121.65 MHz
- GPS operating in normal duty cycle
- No navigation data applied except where required (e.g., Navigation System Tests (Section 2.13))

All modes

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

1.4 TEST LOCATIONS

Antenna Test: Hursley EMC Services Ltd. Hursley, Hants, UK
Satellite Qualitative/Navigation test A.3.8.2.1: Daedalus Airfield, Lee-on-the-Solent, Hants, UK
All other tests: Octagon House Laboratory, Fareham, Hampshire, UK

1.5 MODIFICATIONS

Modification State	Description of Modification still fitted to EUT	Modification Fitted By	Date Modification Fitted
0	As supplied by manufacturer.	N/A	N/A
1	Update to correct Frame Sync for GNSS ST (FS incorrect when EUT transmits without GPS data for GNSS ST).	Manufacturer	25/09/2018
2	Software fix to correct GPS encoded position update interval.	Manufacturer	16/10/2018

The table above details modifications made to the EUT during the test programme. The modifications incorporated during each test are recorded on the appropriate test pages.

1.6 REPORT MODIFICATION RECORD

Issue 1 – First Issue
Issue 2 – High temperature 406 MHz VSWR plots (section 2.6) updated and non-compliance statement revised in sections 2.3 and 2.6.
Issue 3 – Test sample references updated for Operating Lifetime test (Battery Current Measurements)
Issue 4 – Test results summary for Modification States 0 and 1 added to Annex B. Deviation relating to various Modification States added to section 1.2. Table F.E-3 updated with manufacturer declared values.
Issue 5 – Table F-E.5 revised and annex B added to table of contents.
Issue 6 – Summary Table updated with extreme temperature results for Mod State 2. Mod State 0 extreme temperature results moved to Annex B. Table F.E-1 added to main report for Mod State 2 current measurements. Battery current measurements repeated for Mod States 0 and 2 and added to Annex B. Updated Table F.E-2 added to Annex B for retested Mod State 2.

SECTION 2

TEST DETAILS

Emergency Beacons Testing of the
ACR Electronics Inc
PLB-425

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: PLB-425, S/N: 3 RTCM, TUV Ref: TSR4 and Modification State 2							
Transmitter power output	(maximum)	35 - 39	dBm	36.69	36.50	36.13	
	(minimum)			36.53	36.34	35.89	
Power output rise time	(maximum)	< 5	ms	0.29	0.44	0.46	
	(minimum)			0.20	0.38	0.37	
Power output 1ms before burst	(maximum)	< -10	dBm	-17.57	-17.50	-18.85	
	(minimum)			-17.69	-17.64	-18.99	
2. Digital Message Coding							**Result: Pass**
Model: PLB-425, S/N: 3 RTCM, TUV Ref: TSR4 and Modification State 2							
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: PLB-425, S/N: 3 RTCM, TUV Ref: TSR4 and Modification State 2							
Repetition rate, T_R:							
Average T_R		48.5 ≤ T_{Ravg} ≤ 51.5	seconds	50.156	50.114	50.161	
Minimum T_R		47.5 ≤ T_{Rmin} ≤ 48.0	seconds	47.627	47.580	47.612	
Maximum T_R		52.0 ≤ T_{Rmax} ≤ 52.5	seconds	52.417	52.432	52.416	
Standard deviation		0.5 - 2.0	seconds	1.62	1.48	1.62	
Bit rate							
Minimum fb		≥ 396	bits/sec	399.99	399.98	399.97	
Maximum fb		≤ 404	bits/sec	400.01	400.02	400.01	
Total transmission time							
Short message	(maximum)	435.6 - 444.4	ms	N/A	N/A	N/A	
	(minimum)			N/A	N/A	N/A	
Long message	(maximum)	514.8 - 525.2	ms	521.01	520.89	520.91	
	(minimum)			520.94	520.82	520.86	
Unmodulated carrier							
Minimum T1		≥ 158.4	ms	161.05	160.86	160.91	
Maximum T1		≤ 161.6	ms	160.97	160.93	160.96	
First burst delay		≥ 47.5	seconds	51	51	51	

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: PLB-425, S/N: 3 RTCM, TUV Ref: TSR4 and Modification State 2							
Biphase-L		P / F	P / F	P	P	P	* Phase Deviation outside the limits stated in C/S T.007. However, the results are within the Test Facility Accuracy figure stated in C/S T.008.
Rise time	(maximum)	50 - 250	µs	171.3	175.3	178.3	
	(minimum)	50 - 250	µs	156.3	158.4	162.4	
Fall time	(maximum)	50 - 250	µs	191.6	196.7	194.7	
	(minimum)	50 - 250	µs	172.7	175.6	178.6	
Phase deviation: positive	(maximum)	+(1.0 to 1.2)	radians	1.1552	1.2078*	1.2265*	
	(minimum)	+(1.0 to 1.2)	radians	1.0578	1.0343	1.0749	
Phase deviation: negative	(maximum)	-(1.0 to 1.2)	radians	-1.1527	-1.1972	-1.2233*	
	(minimum)	-(1.0 to 1.2)	radians	-1.0129	-1.0330	-1.0705	
Symmetry measurement		≤ 0.05		0.0365	0.0290	0.0298	
5. 406 MHz Transmitted Frequency							**Result: Pass**
Model: PLB-425, S/N: 3 RTCM, TUV Ref: TSR4 and Modification State 2							
Nominal Value	(maximum)	C/S T.001	MHz	406.0309566	406.0309109	406.0309188	
	(minimum)			406.0309564	406.0309108	406.0309186	
Short-term stability	(maximum)	≤ $2x10^{-9}$	/100ms	10.894E-11	77.551E-12	90.162E-12	
	(minimum)			89.990E-12	64.581E-12	74.130E-12	
Medium-term stability – Slope	(maximum)	(-1 to +1)$x10^{-9}$	/minutes	-88.622E-13	13.839E-11	96.594E-12	
	(minimum)			-10.301E-11	-34.260E-12	76.025E-13	
Medium-term stability – Residual frequency variation	(maximum)	≤ $3x10^{-9}$		29.639E-11	45.871E-11	30.491E-11	
	(minimum)			24.550E-11	24.421E-11	18.207E-11	
6. Spurious Emissions into 50ohms							**Result: Pass**
Model: PLB-425, S/N: 3 RTCM, TUV Ref: TSR4 and Modification State 2							
In band (406.0 – 406.1 MHz)		C/S T.001 mask	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)	
7. 406 MHz VSWR Check							**Result: Non-Compliance**
Model: PLB-425, S/N: 3 RTCM, TUV Ref: TSR4 and Modification State 0							
Nominal Value	(maximum)	C/S T.001	MHz	406.0309379	406.0309098	406.0309288	* Phase Deviation outside the limits stated in C/S T.007. However, the results are within the Test Facility Accuracy figure stated in C/S T.008.
	(minimum)			406.0309355	406.0309097	406.0309267	
Modulation rise time	(maximum)	50-250	µs	174.4	181.3	175.4	
	(minimum)	50-250	µs	160.3	161.3	163.4	
Modulation fall time	(maximum)	50-250	µs	195.7	199.6	193.6	
	(minimum)	50-250	µs	177.7	180.6	180.6	
Modulation phase deviation: positive	(maximum)	+ (1.0 to 1.2)	radians	1.1818	1.1869	1.2289*	
	(minimum)	+ (1.0 to 1.2)	radians	1.0584	1.0754	1.0909	
Modulation phase deviation: negative	(maximum)	- (1.0 to 1.2)	radians	-1.1692	-1.1862	-1.2227*	
	(minimum)	- (1.0 to 1.2)	radians	-1.0151	-1.0297	-1.0593	
Modulation symmetry measurement		≤ 0.05		0.0274	0.0365	0.0302	
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: PLB-425, S/N: 3 RTCM, TUV Ref: TSR4 and Modification State 0 **Model: PLB-425, S/N: 7 C/S, TUV Ref: TSR23 and Modification State 2 (PIE Test Only)**						
Frame sync	011010000	P / F	P	P	P	
Format flag	1 / 0	bit value	1	1	1	
Single radiated burst	≤440 / 520 (±1%)	ms	441.205	440.807	440.962	
Default position data (if applicable)	correct	P / F	P	P	P	
Description	provided	Y / N		Y		
Design data on protection against repetitive self-test mode transmissions	provided	Y / N		Y		
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	See Table F.E-3
Distinct indication of RF power being emitted	provided	Y / N	Y	Y	Y	
Indication of Self-Test result	provided	Y / N	Y	Y	Y	
Distinct indication of insufficient battery capacity	provided	Y / N		Y		See Table F.E-5
Maximum duration of Self-Test mode	≤ maximum duration of Self-Test	sec	13	13	13	
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: PLB-425, S/N: 3 RTCM, TUV Ref: TSR4 and Modification State 1						
Frame sync	011010000	P / F	P	P	P	
Format flag	1 / 0	bit value	1	1	1	
Radiated burst duration	≤ 520 (+1%)	ms	521.00	520.91	520.95	
Position data except for ELT (DT) (if applicable)	must be within 500 m (or 5.25 km for User Location Protocol) of the actual position	P / F	P	P	P	
Position data for ELT(DT)	must be within 200 m of the actual horizontal position and 700 m of the altitude	P / F	N/A	N/A	N/A	
Design data showing how GNSS Self-test is limited in number of transmissions and duration	provided	Y / N		Y		
Single burst verification (if applicable)	one burst	P / F	P	P	P	
121.5 MHz RF power (if applicable)	verify that RF power is emitted	Y / N	N	N	N	
406 MHz power (if applicable)	verify that RF power is emitted	Y / N	Y	Y	Y	
Maximum duration of GNSS Self-tests	Manufacturer to specify value	s	110	110	110	
Actual duration of Self-test with encoded location	Less than maximum duration	s	60	57	54	
Maximum number of GNSS Self-tests (only beacons with internal navigation devices)	Manufacturer to specify number	Number		20		Manufacturer specified number: 20
Distinct indication to register successful completion or failure of the GNSS self-test	must be provided	Y/N	Y	Y	Y	
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 or further GNSS receiver current drain	must be provided	Y/N		Y		

Parameters to be Measured	Range of Specification	Units	Test Results		Comments
9. Thermal Shock					**Result: Pass**
Model: PLB-425, S/N: 3 RTCM, TUV Ref: TSR4 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	406.0309423	406.0309463	
Short-term stability	≤ $2x10^{-9}$	/100ms	68.209E-12	12.391E-11	
Medium-term stability – Slope	(-2 to +2)$x10^{-9}$	/min	-58.382E-12	85.552E-11	
Medium-term stability – Residual frequency variation	≤ $3x10^{-9}$		13.261E-11	75.879E-11	
Transmitter power output	35 - 39	dBm	36.78	37.01	
Digital message	correct	P/F	P		

Parameters to be Measured	Range of Specification	Units	Test Results		Comments
10. Operating Lifetime at Minimum Temperature					**Result: Pass**
Model: PLB-425, S/N: 3 RTCM, TUV Ref: TSR4 and Modification State 0 (used for Lifetime Test) **Model: PLB-425, S/N: 11 C/S, TUV Ref: TSR2 and Modification State 0 (used for Battery Current Measurements)** **Model: PLB-425, S/N: 11 C/S, TUV Ref: TSR2 and Modification State 2 (used for Battery Current Measurement comparison)**					
Pre-test battery discharge duration (operating) required		Hours	3.86		
Pre-test battery discharge duration (operating)		Hours	4.5		
Duration	>24	Hours	28.01 Hours at Tmin = -20°C		Time to first failure.
Effective Operating Lifetime duration	>24	Hours	28.01 Hours at Tmin = -20°C		
Transmitted Frequency			Min	Max	Min/Max results are up to the manufacturer declared lifetime of 24hrs. MTS results exclude the first 30 mins of data (included in the test results section of this report).
Nominal value	C/S T.001	MHz	406.0309576	406.0309651	
Short-term stability	≤ $2x10^{-9}$	/100ms	6.553E-11	1.853E-10	
Medium-term stability – Slope	(-1 to +1)$x10^{-9}$	/min	-9.684E-11	7.591E-11	
Medium-term stability – Residual frequency variation	≤ $3x10^{-9}$		8.108E-11	3.560E-10	
Transmitter power output	35 - 39	dBm	36.16	37.46	
Digital message	correct	P/F	P		
Homer transmitter continuous operation during the lifetime test		hours	36.00		
			Start of Test	End of Test	'End of test' results are up to the manufacturer declared lifetime of 24hrs.
Homer frequency		MHz	121.499	121.499	
Homer peak power level		dBm	16.6	16.6	
Homer transmitter duty cycle		%	94.8	94.7	

Parameters to be Measured	Range of Specification	Units	Test Results				Comments
11. Temperature Gradient (5°C/hr)							**Result: Pass**
Model: PLB-425, S/N: 3 RTCM, TUV Ref: TSR4 and Modification State 0							
Full Test							
Transmitted Frequency			Min	Max			
Nominal value	C/S T.007	MHz	406.0309103	406.0309577			
Short-term stability	≤ $2x10^{-9}$	/100ms	55.085E-12	16.835E-11			
Medium-term stability – Slope[1]	(-1 to +1)$x10^{-9}$	/min	-5.15E-11	1.08E-10			Data for points A to B, C+15 min to D and E+15 min to F
	(-2 to +2)$x10^{-9}$	/min	-4.50E-10	4.53E-10			Data for points B to C+15 min and D to E+15 min
Medium-term stability – Residual frequency variation	≤ $3x10^{-9}$		48.994E-12	58.938E-11			
Transmitter power output	35 – 39	dBm	36.16	37.01			
Digital message	correct	P/F	P				
12. Oscillator Aging							
Model: PLB-425, S/N: 3 RTCM, TUV Ref: TSR4 and Modification State 0							
5 year carrier nominal frequency variation	provided	Y / N	Y				
MTS analysis (if applicable)	Must demonstrate compliance	P / F	P				
13. Protection Against Continuous Transmission							
Description	provided	Y / N	Y				
14. Satellite Qualitative Tests							**Result: Pass**
Model: PLB-425, S/N: 7 C/S, TUV Ref: TSR23 and Modification State 1 (Config 7) **Model: PLB-425, S/N: 7 C/S, TUV Ref: TSR23 and Modification State 2 (Config 8)**							
Test Configuration	As per C/S T.007		Configuration				
			5	6	7	8	
15 Hex ID Decoded by LUT	correct	P / F	-	-	P	P	
Doppler Location results with error ≤ 5km	≥ 80	%	-	-	100	95	

Parameters to be Measured	Range of Specification	Units	Test Results				Comments
15. Antenna Characteristics							**Result: Pass**
Model: PLB-425, S/N: #15, TUV Ref: TSR1 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	-	-	0.47	0.47	
$EIRP_{maxEOL}$	≤ 43	dBm	-	-	42.1	39.5	
$EIRP_{minEOL}$	≥ 32	dBm	-	-	32.3	33.9	$EIRP_{minEOL}$ limit decreases to 30 dBm for Configuration 4
16. Beacon Coding Software							**Result: Pass***
Sample message for each coding option of the applicable coding types	correct	P / F	P				*Sample messages provided by Manufacturer (see Annex A) for coding options identified in supplied Annex G (Application Form) only.
Sample self-test message for each coding option of the applicable coding types	correct	P / F	P				

Parameters to be Measured	Range of Specification	Units	Test Results			Comments
17. Navigation System						**Result: Pass**
Model: PLB-425, S/N: 7 TUV Ref: TSR23 and Modification State 0 (SLP A.3.8.2) **Model: PLB-425, S/N: 3 TUV Ref: TSR4 and Modification State 1 (SLP A.3.8.1, A.3.8.6)** **Model: PLB-425, S/N: 3 TUV Ref: TSR4 and Modification State 2 (All NLP Tests)** **Model: PLB-425, S/N: 7 TUV Ref: TSR23 and Modification State 2 (NLP A.3.8.2)**						
Location protocol	C/S T.001		National	Standard	User	
Position data default values	correct	P / F	P	P	-	
Configuration 7						
Position accuracy - A.3.8.2.1	C/S T.001	m	35.6	35.6	-	
Position Acquisition Time - A.3.8.2.1	<10/1	min	0.86	0.85	-	
Position accuracy - A.3.8.2.2	C/S T.001	m	24.2	24.2	-	
Position Acquisition Time - A.3.8.2.2	<10/1	min	0.86	0.85	-	
Configuration 8						
Position accuracy - A.3.8.2.1	C/S T.001	m	35.6	35.6	-	
Position Acquisition Time - A.3.8.2.1	<10/1	min	0.86	0.85	-	
Position accuracy - A.3.8.2.2	C/S T.001	m	24.2	24.2	-	
Position Acquisition Time - A.3.8.2.2	<10/1	min	0.86	0.85	-	
Encoded position data update interval	>5	min	5.02	5.01	-	
Position clearance after deactivation	cleared	P / F	P	P	-	
Position data input update interval (as applicable)	20/1	Min	N/A	N/A	-	
Position data encoding	correct	P / F	P	P	-	Manufacturer Supplied Data: see Annex A
Retained last valid position after navigation input lost	240(±5)	min	244.38	243.76	-	
Default position data transmitted after 240(±5) minutes without valid position data	cleared	P / F	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 for details

2.1 POWER OUTPUT

2.1.1 Specification

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

2.1.2 Equipment Under Test and Modification State

ResQlink (PLB 425) S/N: 3 RTCM - Modification State 2

2.1.3 Date of Test

19 October 2018 & 18 January 2019

2.1.4 Test Equipment Used

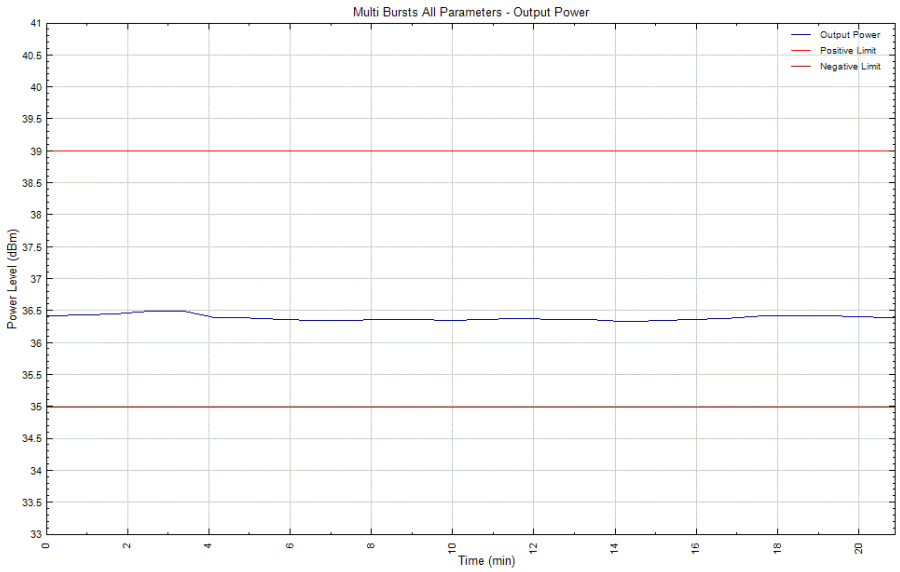
The major items of test equipment used for the above tests are identified in Section 3.1.

2.1.5 Environmental Conditions

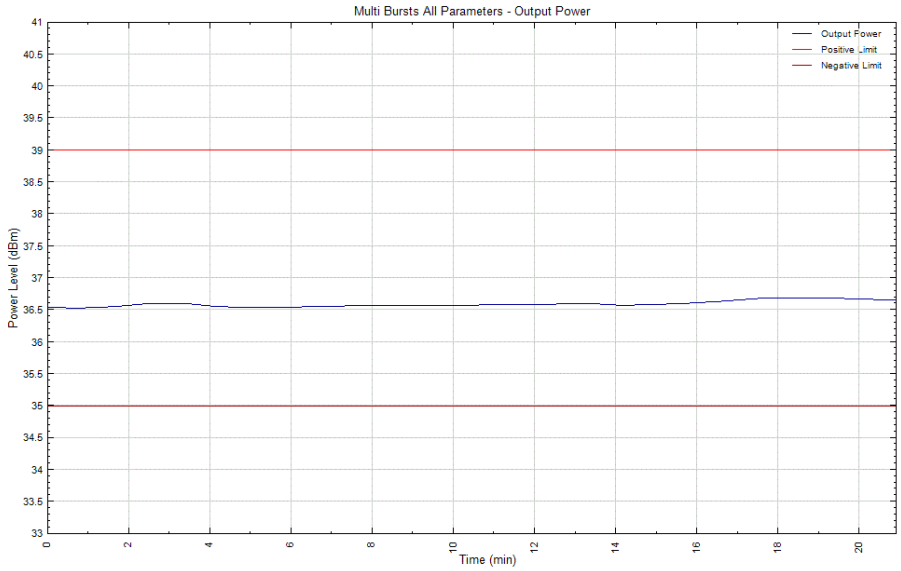
Ambient Temperature 21.9 - 24.8°C
Relative Humidity 24.3 - 45.4%

2.1.6 Test Results

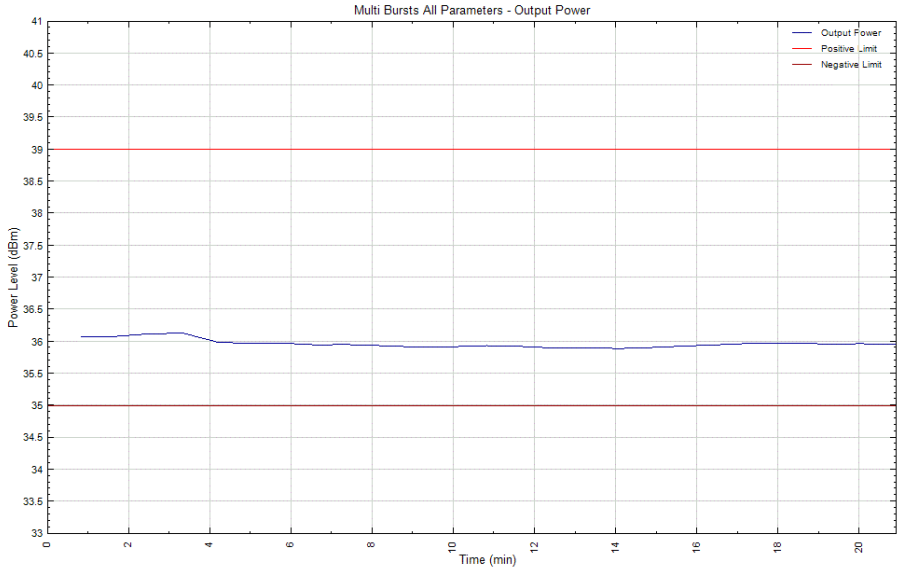
Ambient Temperature



Low Temperature



High Temperature



Summary

The EUT complies with clause A.3.2.2 of Cospas-Sarsat T.007.

2.2 DIGITAL MESSAGE

2.2.1 Specification

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

2.2.2 Equipment Under Test and Modification State

ResQlink (PLB 425) S/N: 3 RTCM - Modification State 2

2.2.3 Date of Test

19 October 2018 & 18 January 2019

2.2.4 Test Equipment Used

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

2.2.5 Environmental Conditions

Ambient Temperature 21.9 - 24.8°C
Relative Humidity 24.3 - 45.4%

2.2.6 Test Results

Test Duration: 20 minutes
No. of bursts: 26

Ambient Temperature

Message	FFFE2F8C9EF9C0637FDFF83D15B783E0F66C		
Hex ID	193DF380C6FFBFF		
Position	None - Default Values		
Parameter	Bit	Data Bits	Decoded Value
Bit synchronization	1-15	111111111111111	111111111111111
Frame synchronization	16-24	000101111	000101111
Format Flag	25	1	1
Protocol Flag	26	0	0
Country Code	27-36	0011001001	Albania (Republic of)
Protocol Code	37-40	1110	Standard Test Location Protocol
Undefined	41-64	11111001110000000110011	11111001110000000110011
N/S	65	0	Default
Latitude Degrees	66-72	1111111	Default
Latitude Minutes	73-74	11	Default
E/W	75	0	Default
Longitude Degrees	76-83	11111111	Default
Longitude Minutes	84-85	11	Default
BCH Code (21 Bit)	86-106	00000111010001010110	00000111010001010110
Calculated BCH Code (21 Bit)	-	00000111010001010110	00000111010001010110
Supplementary Data Fixed	107-110	1101	1101
Encoded Position Data Source	111	1	Internal
121.5 MHz Homing	112	1	Yes
Delta Latitude +/-	113	1	Default
Delta Latitude Minutes	114-118	00000	Default
Delta Latitude Seconds	119-122	1111	Default
Delta Longitude +/-	123	1	Default
Delta Longitude Minutes	124-128	00000	Default
Delta Longitude Seconds	129-132	1111	Default
BCH Code (12 Bit)	133-144	011001101100	011001101100
Calculated BCH Code (12 Bit)	-	011001101100	011001101100

Low Temperature

Message	FFFE2F8C9EF9C0637FDFF83D15B783E0F66C		
Hex ID	193DF380C6FFBFF		
Position	None - Default Values		
Parameter	Bit	Data Bits	Decoded Value
Bit synchronization	1-15	111111111111111	111111111111111
Frame synchronization	16-24	000101111	000101111
Format Flag	25	1	1
Protocol Flag	26	0	0
Country Code	27-36	0011001001	Albania (Republic of)
Protocol Code	37-40	1110	Standard Test Location Protocol
Undefined	41-64	11111001110000000110011	11111001110000000110011
N/S	65	0	Default
Latitude Degrees	66-72	1111111	Default
Latitude Minutes	73-74	11	Default
E/W	75	0	Default
Longitude Degrees	76-83	11111111	Default
Longitude Minutes	84-85	11	Default
BCH Code (21 Bit)	86-106	00000111010001010110	00000111010001010110
Calculated BCH Code (21 Bit)	-	00000111010001010110	00000111010001010110
Supplementary Data Fixed	107-110	1101	1101
Encoded Position Data Source	111	1	Internal
121.5 MHz Homing	112	1	Yes
Delta Latitude +/-	113	1	Default
Delta Latitude Minutes	114-118	00000	Default
Delta Latitude Seconds	119-122	1111	Default
Delta Longitude +/-	123	1	Default
Delta Longitude Minutes	124-128	00000	Default
Delta Longitude Seconds	129-132	1111	Default
BCH Code (12 Bit)	133-144	011001101100	011001101100
Calculated BCH Code (12 Bit)	-	011001101100	011001101100

High Temperature

Message	FFFE2F8C9F0018DFC0FF04F9E4379F3C0010		
Hex ID	193E0031BF81FE0		
Position	None - Default Values		
Parameter	Bit	Data Bits	Decoded Value
Bit synchronization	1-15	111111111111111	111111111111111
Frame synchronization	16-24	000101111	000101111
Format Flag	25	1	1
Protocol Flag	26	0	0
Country Code	27-36	0011001001	Albania (Republic of)
Protocol Code	37-40	1111	National Test Location Protocol
National ID Number	41-58	000000000001100011	000000000001100011
N/S	59	0	Default
Latitude Degrees	60-66	1111111	Default
Latitude Minutes	67-71	00000	Default
E/W	72	0	Default
Longitude Degrees	73-80	11111111	Default
Longitude Minutes	81-85	00000	Default
BCH Code (21 Bit)	86-106	100111110011110010000	100111110011110010000
Calculated BCH Code (21 Bit)	-	100111110011110010000	100111110011110010000
Supplementary Data Fixed	107-109	110	110
Additional Data Flag	110	1	Delta Position
Encoded Position Data Source	111	1	Internal
121.5 MHz Homing	112	1	Yes
Delta Latitude +/-	113	1	Default
Delta Latitude Minutes	114-115	00	Default
Delta Latitude Seconds	116-119	1111	Default
Delta Longitude +/-	120	1	Default
Delta Longitude Minutes	121-122	00	Default
Delta Longitude Seconds	123-126	1111	Default
National Use	127-132	000000	000000
BCH Code (12 Bit)	133-144	000000010000	000000010000
Calculated BCH Code (12 Bit)	-	000000010000	000000010000

Summary

The EUT complies with clause A.3.1.4 of Cospas-Sarsat T.007.

2.3 MODULATION

2.3.1 Specification

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

2.3.2 Equipment Under Test and Modification State

ResQlink (PLB 425) S/N: 3 RTCM - Modification State 2

2.3.3 Date of Test

19 October 2018 & 18 January 2019

2.3.4 Test Equipment Used

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

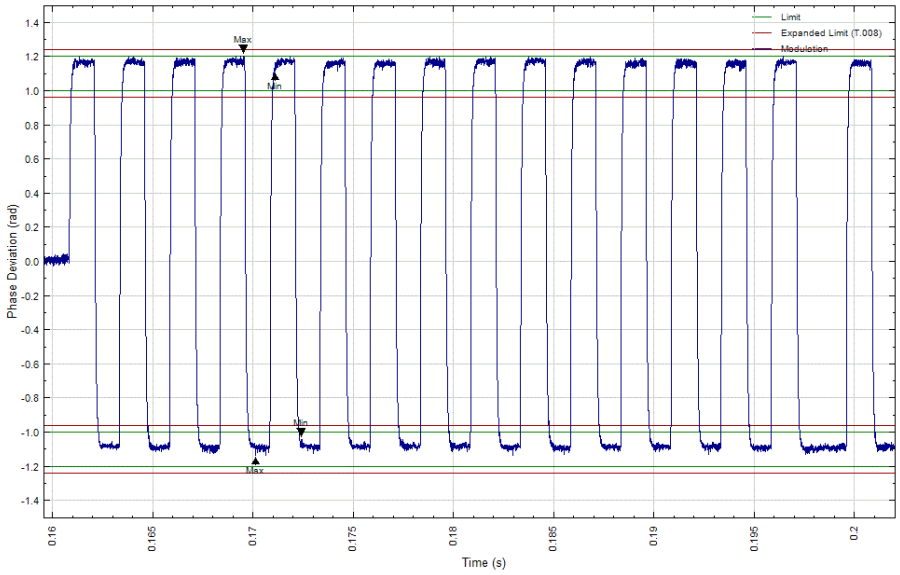
2.3.5 Environmental Conditions

Ambient Temperature 21.9 - 24.8°C
Relative Humidity 24.3 - 45.4%

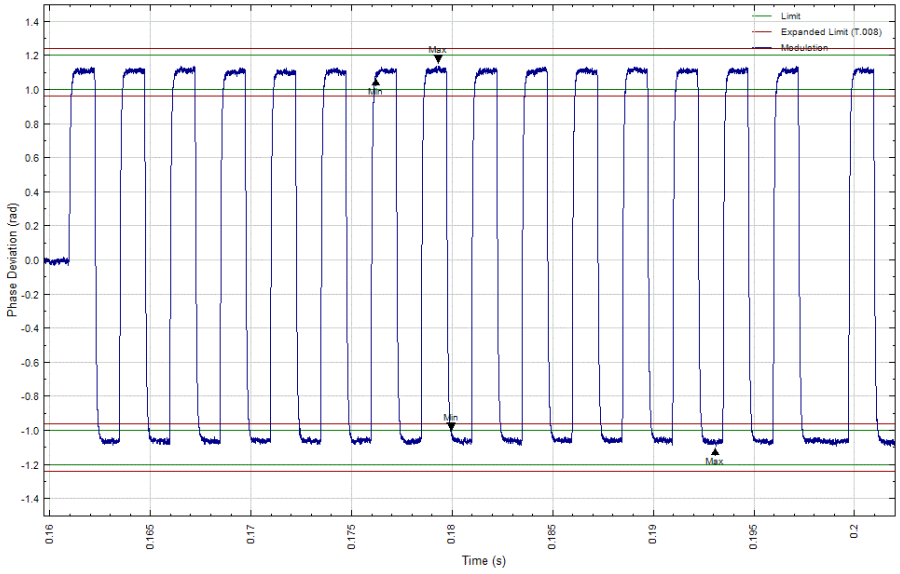
2.3.6 Test Results

Test Duration: 20 minutes
No. of bursts: 26
Note: Worst Case Modulation plots shown for each temperature

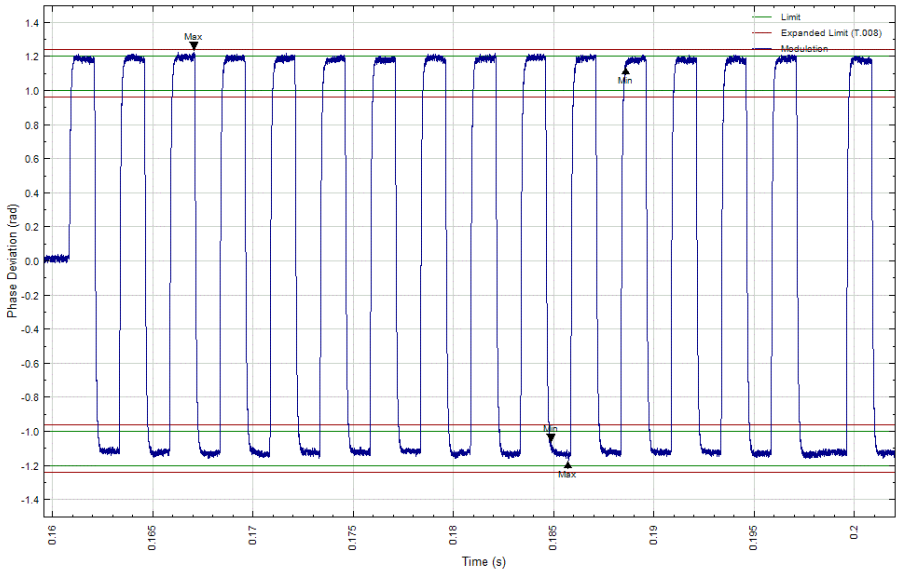
Ambient Temperature



Low Temperature



High Temperature



Summary

The EUT fails to comply* with clause A.3.2.3 of Cospas-Sarsat T.007.

* Phase Deviation (Maximum Positive at ambient and +55°C, and Maximum Negative at +55°C): outside the limits stated in C/S T.007. However, the results are within the Test Facility Accuracy figure stated in C/S T.008.

2.4 406 MHZ TRANSMITTED FREQUENCY

2.4.1 Specification

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

2.4.2 Equipment Under Test and Modification State

ResQlink (PLB 425) S/N: 3 RTCM - Modification State 2

2.4.3 Date of Test

19 October 2018 & 18 January 2019

2.4.4 Test Equipment Used

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

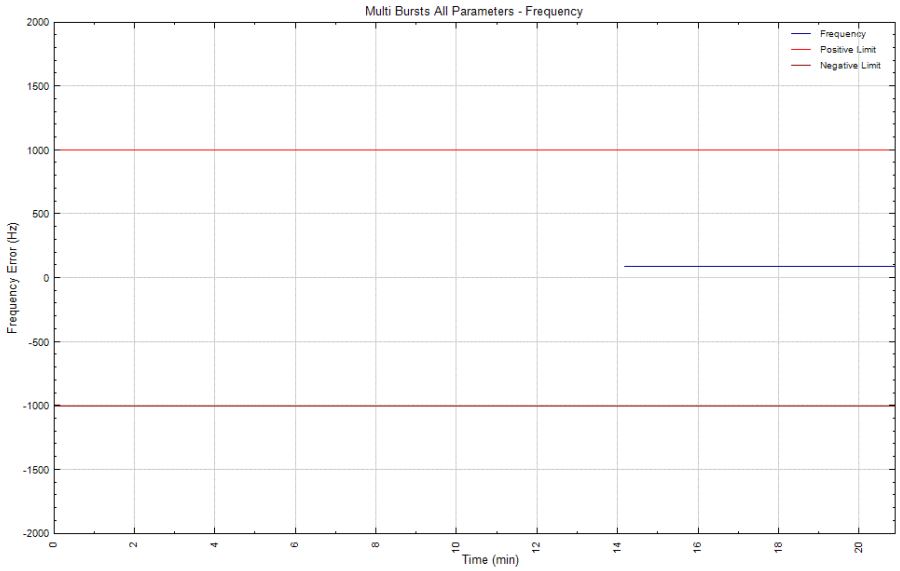
2.4.5 Environmental Conditions

Ambient Temperature 21.9 - 24.8°C
Relative Humidity 24.3 - 45.4%

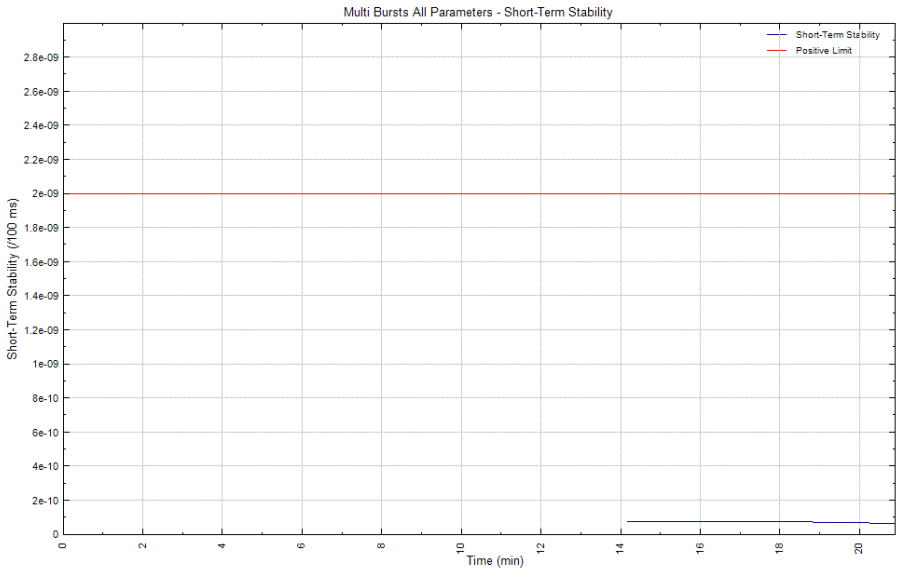
2.4.6 Test Results

Ambient Temperature

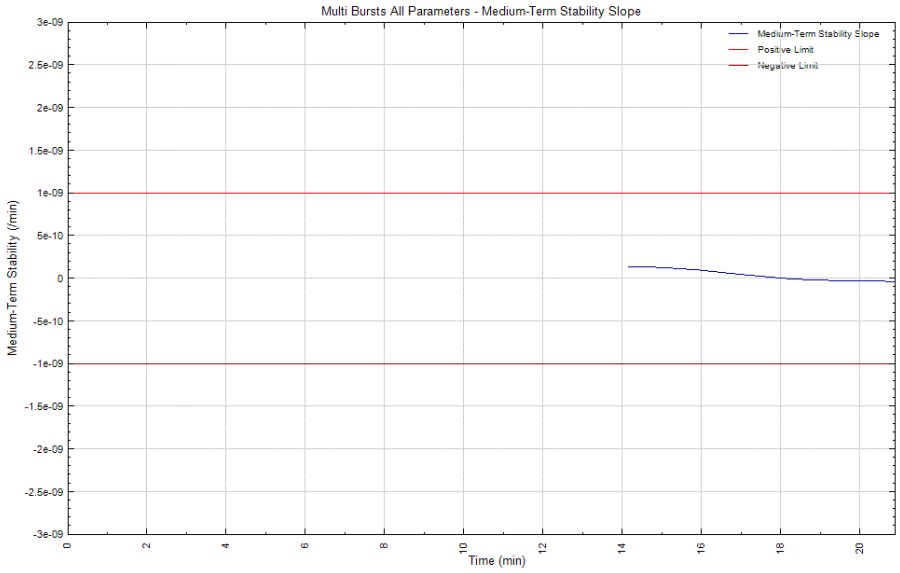
Nominal Frequency



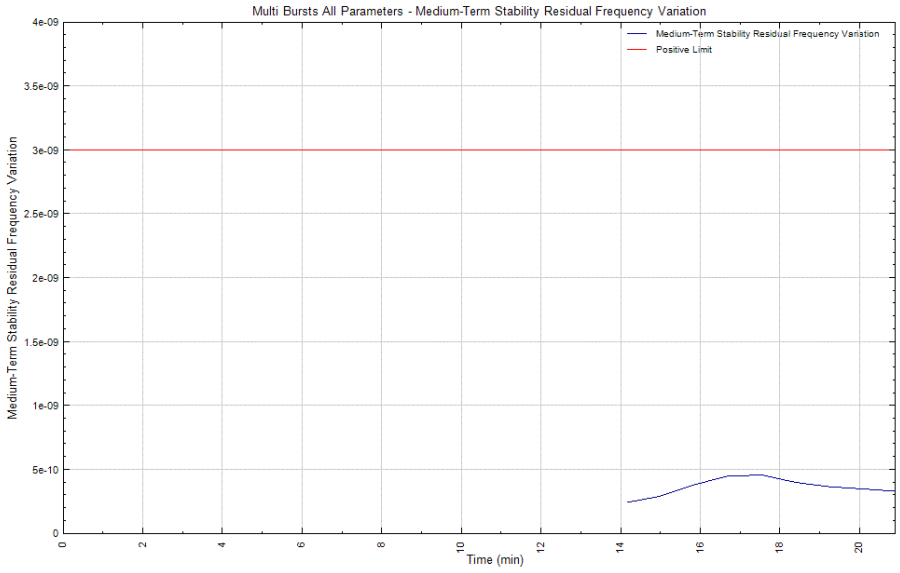
Short Term Stability



Medium Term Stability – Slope

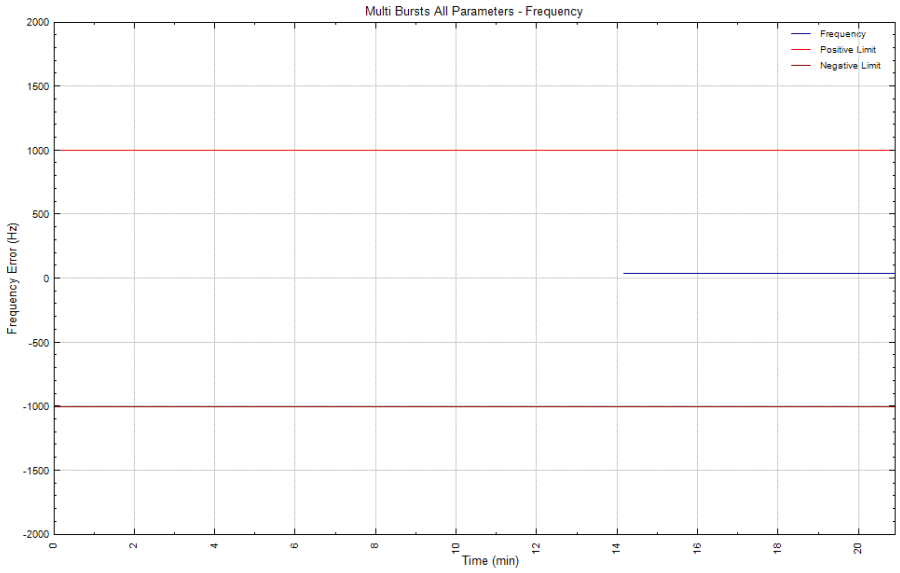


Medium Term Stability – Residual

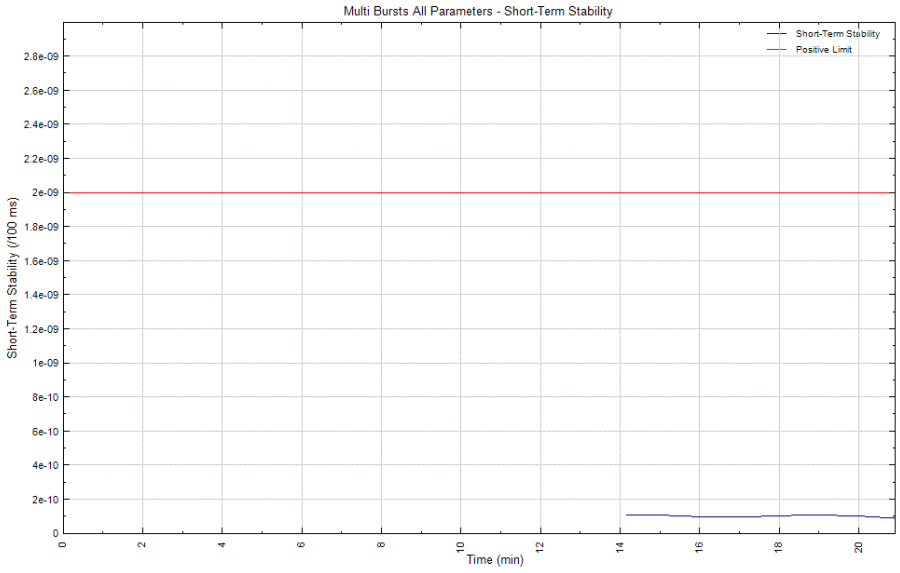


Low Temperature

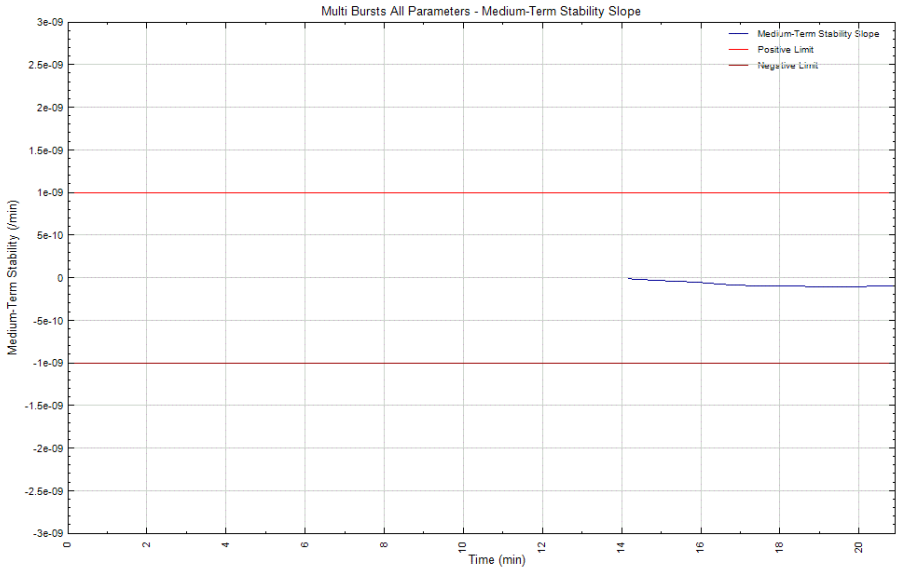
Nominal Frequency



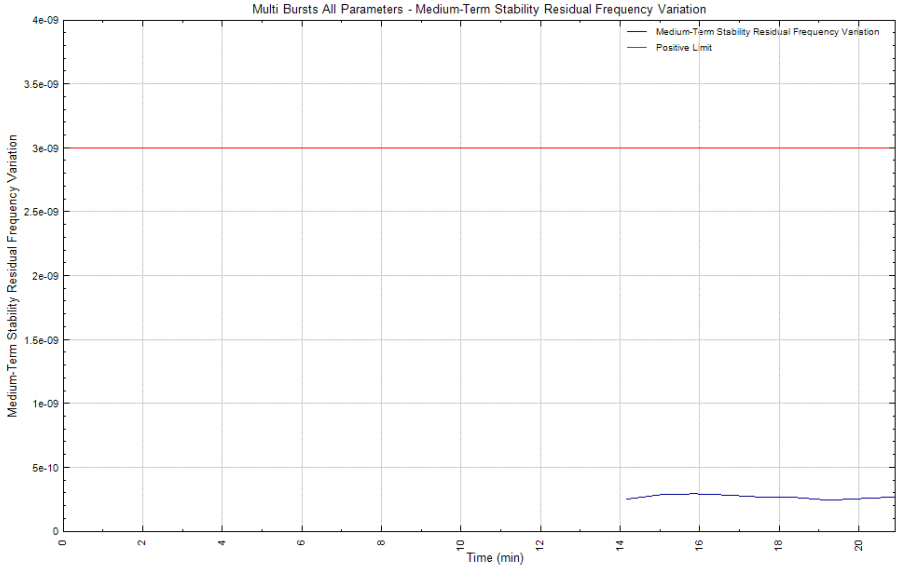
Short Term Stability



Medium Term Stability – Slope

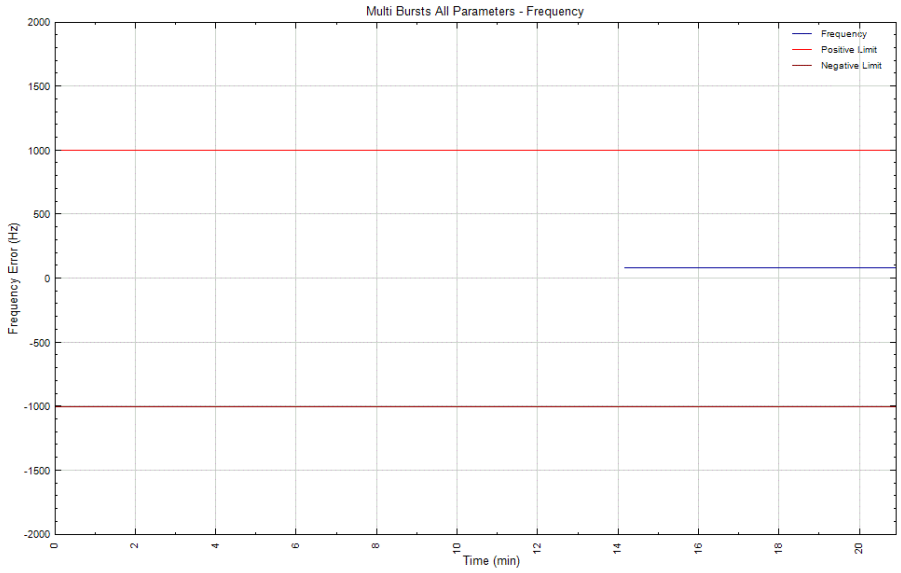


Medium Term Stability – Residual

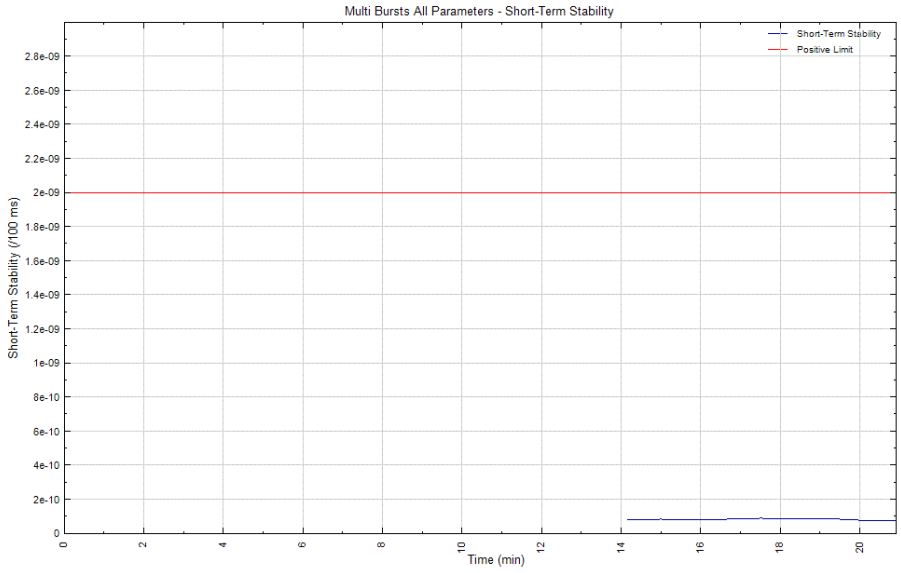


High Temperature

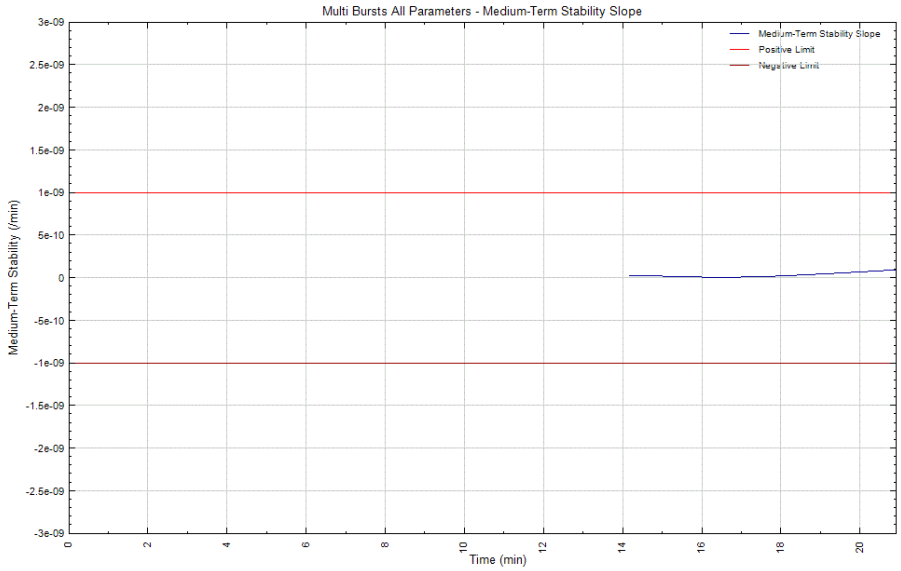
Nominal Frequency



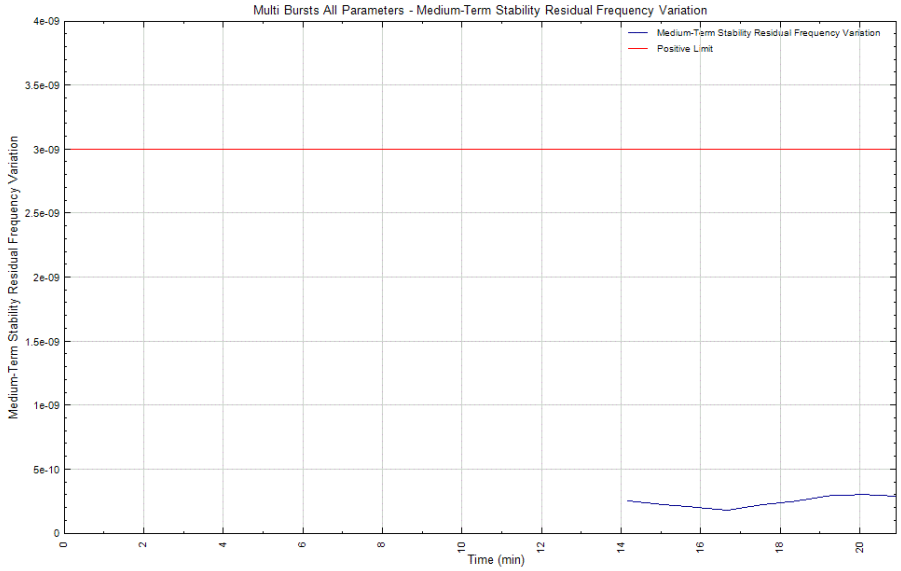
Short Term Stability



Medium Term Stability – Slope



Medium Term Stability – Residual



Summary

The EUT complies with clause A.3.2.1 of Cospas-Sarsat T.007.

2.5 SPURIOUS EMISSION INTO 50 OHMS

2.5.1 Specification

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

2.5.2 Equipment Under Test and Modification State

ResQlink (PLB 425) S/N: 3 RTCM - Modification State 2 (Ambient Only)
ResQlink (PLB 425) S/N: 3 RTCM - Modification State 0 (Low and High Temperature)

2.5.3 Date of Test

19 October 2018 & 18 January 2019

2.5.4 Test Equipment Used

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

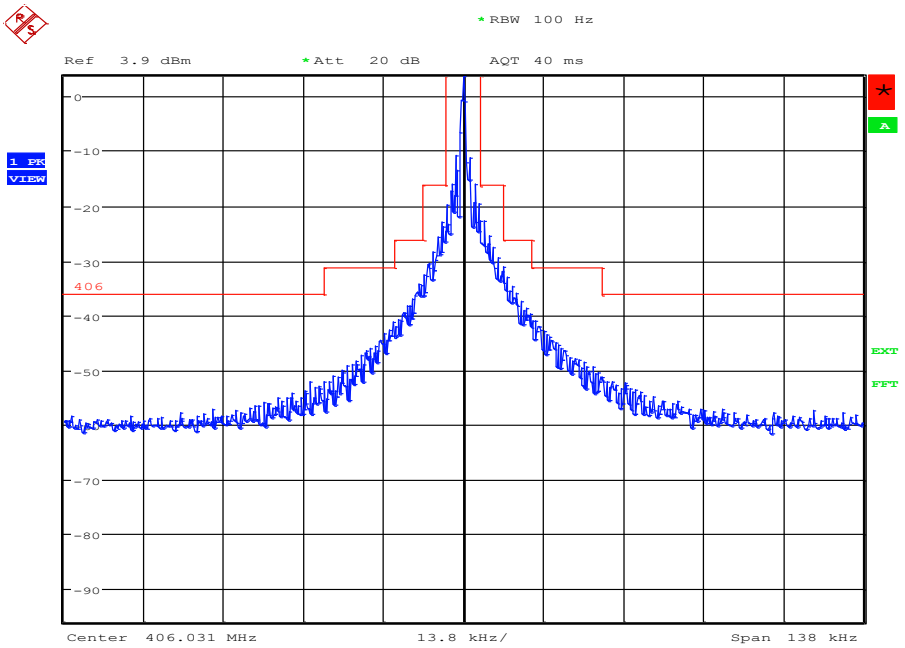
2.5.5 Environmental Conditions

Ambient Temperature 21.9 - 24.8°C
Relative Humidity 24.3 - 45.4%

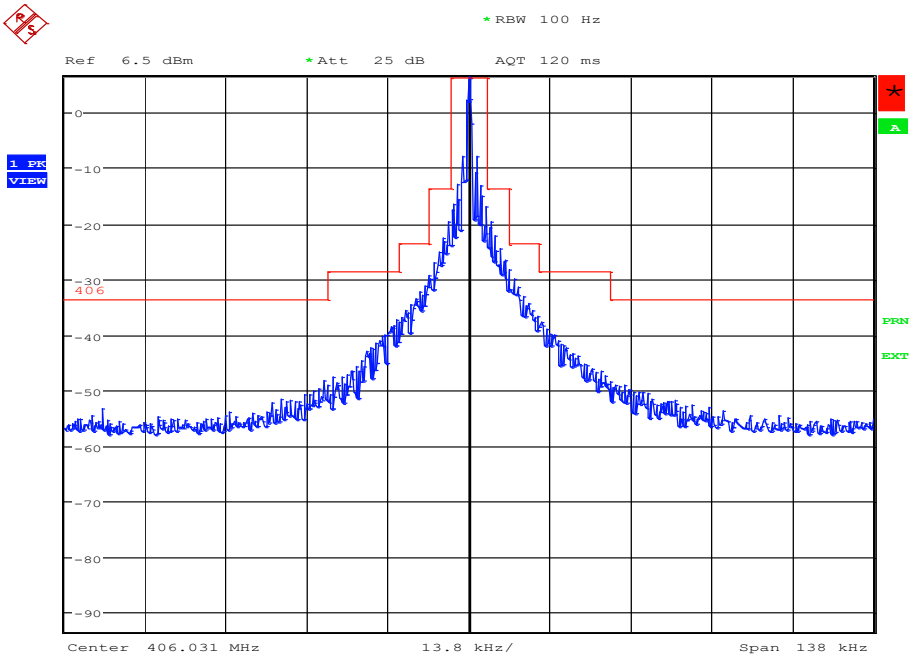
2.5.6 Test Results

Test Duration: 20 minutes
No. of bursts: 26

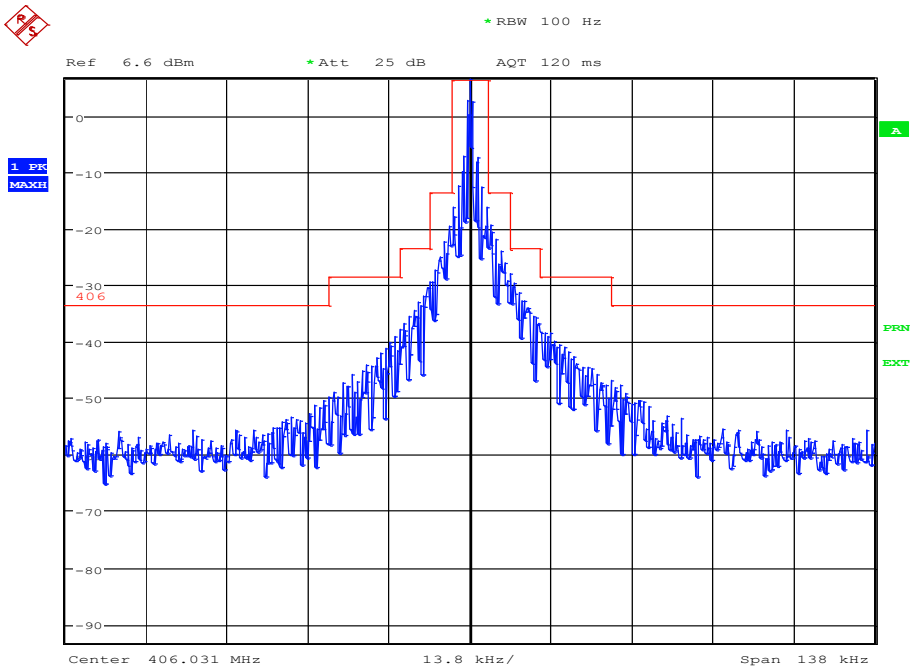
Ambient Temperature



Low Temperature



High Temperature



Summary

The EUT complies with clause A.3.2.2.4 of Cospas-Sarsat T.007.

2.6 406 MHZ VSWR CHECK

2.6.1 Specification

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

2.6.2 Equipment Under Test and Modification State

ResQlink (PLB 425) S/N: 3 RTCM - Modification State 0

2.6.3 Date of Test

17 September 2018 & 18 September 2018

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 23.3 - 24.8°C
Relative Humidity 40.6 - 45.4%

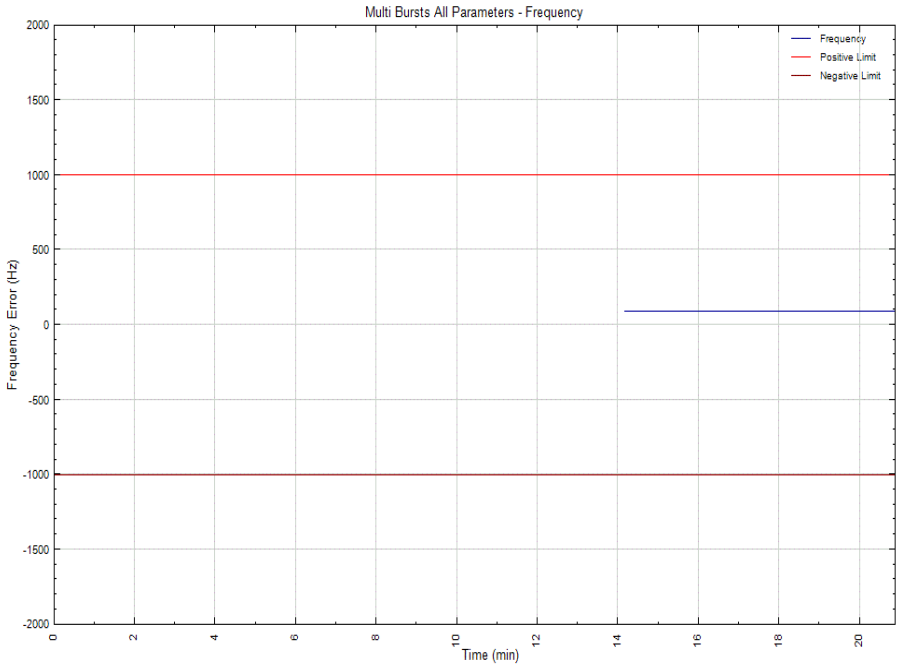
2.6.6 Test Results

Test Duration: 20 minutes
No. of bursts: 26
Note: Worst Case Modulation plots shown for each temperature

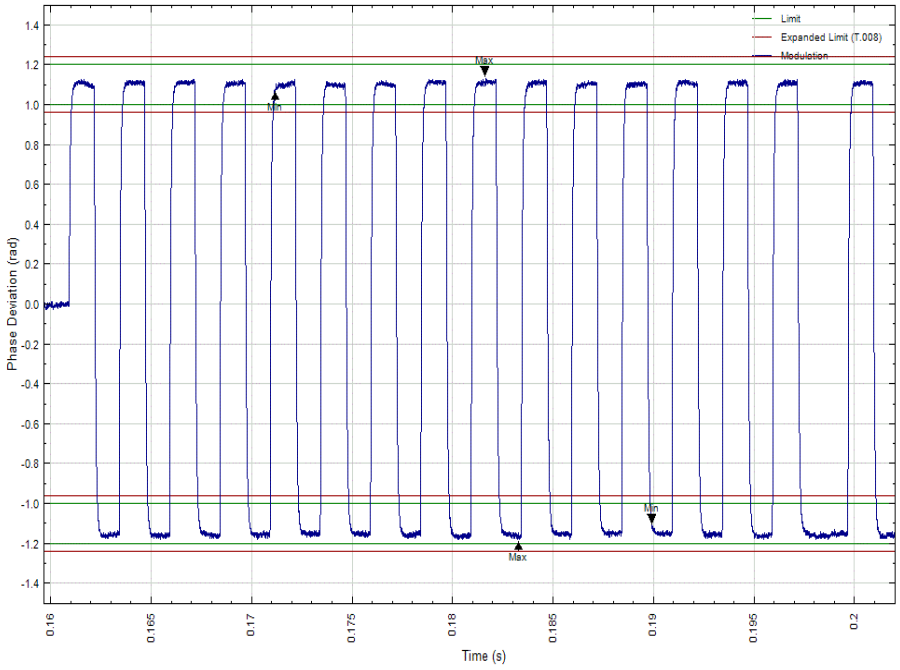
Ambient Temperature

Message	FFFE2F8C97F9C0637FDFFF11B23783E0F66C		
Hex ID	192FF380C6FFBFF		
Position	None - Default Values		
Parameter	Bit	Data Bits	Decoded Value
Bit synchronization	1-15	111111111111111	111111111111111
Frame synchronization	16-24	000101111	000101111
Format Flag	25	1	1
Protocol Flag	26	0	0
Country Code	27-36	0011001001	Albania (Republic of)
Protocol Code	37-40	0111	Standard Location Protocol - PLB-serial
C/S TA No.	41-50	1111100111	1111100111
Serial Number	51-64	00000001100011	99
N/S	65	0	Default
Latitude Degrees	66-72	1111111	Default
Latitude Minutes	73-74	11	Default
E/W	75	0	Default
Longitude Degrees	76-83	11111111	Default
Longitude Minutes	84-85	11	Default
BCH Code (21 Bit)	86-106	11100010011011001000	11100010011011001000
Calculated BCH Code (21 Bit)	-	11100010011011001000	11100010011011001000
Supplementary Data Fixed	107-110	1101	1101
Encoded Position Data Source	111	1	Internal
121.5 MHz Homing	112	1	Yes
Delta Latitude +/-	113	1	Default
Delta Latitude Minutes	114-118	00000	Default
Delta Latitude Seconds	119-122	1111	Default
Delta Longitude +/-	123	1	Default
Delta Longitude Minutes	124-128	00000	Default
Delta Longitude Seconds	129-132	1111	Default
BCH Code (12 Bit)	133-144	011001101100	011001101100
Calculated BCH Code (12 Bit)	-	011001101100	011001101100

Frequency Plot



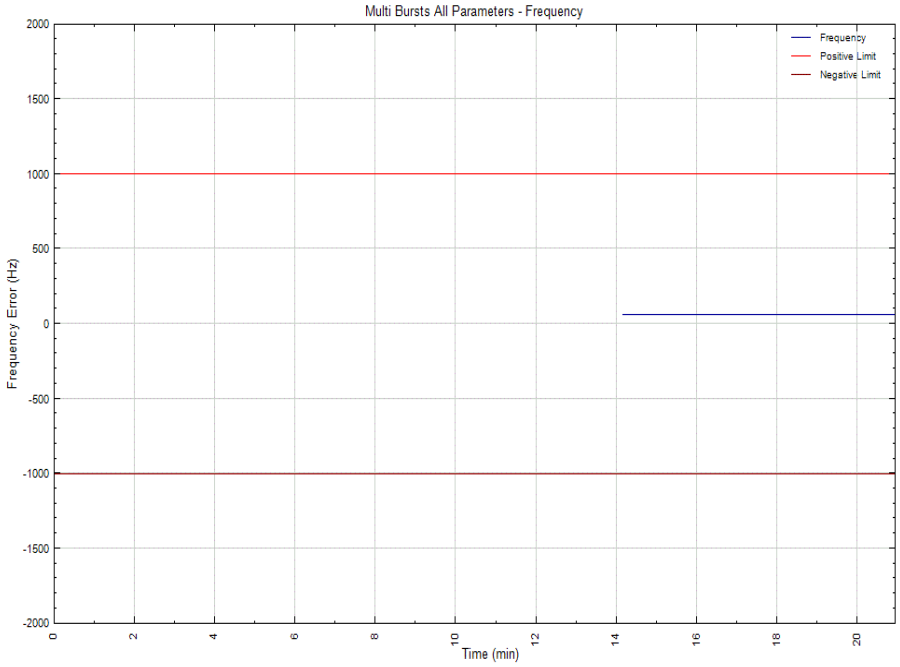
Modulation Plot



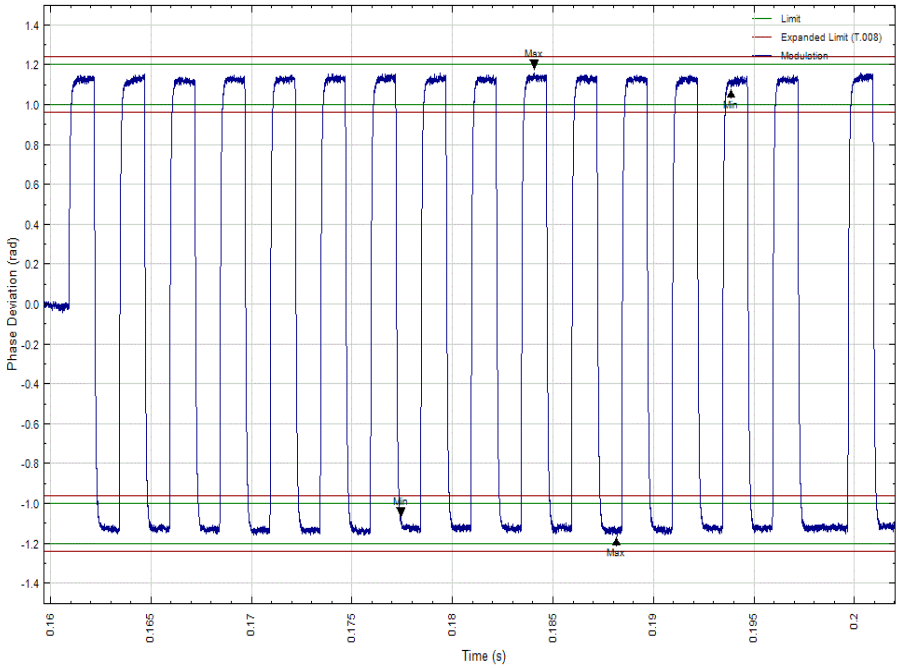
Low Temperature

Message	FFFE2F8C97F9C0637FDFFF11B23783E0F66C		
Hex ID	192FF380C6FFBFF		
Position	None - Default Values		
Parameter	Bit	Data Bits	Decoded Value
Bit synchronization	1-15	111111111111111	111111111111111
Frame synchronization	16-24	000101111	000101111
Format Flag	25	1	1
Protocol Flag	26	0	0
Country Code	27-36	0011001001	Albania (Republic of)
Protocol Code	37-40	0111	Standard Location Protocol - PLB-serial
C/S TA No.	41-50	1111100111	1111100111
Serial Number	51-64	00000001100011	99
N/S	65	0	Default
Latitude Degrees	66-72	1111111	Default
Latitude Minutes	73-74	11	Default
E/W	75	0	Default
Longitude Degrees	76-83	11111111	Default
Longitude Minutes	84-85	11	Default
BCH Code (21 Bit)	86-106	11100010001101100 1000	11100010001101100 1000
Calculated BCH Code (21 Bit)	-	11100010001101100 1000	11100010001101100 1000
Supplementary Data Fixed	107-110	1101	1101
Encoded Position Data Source	111	1	Internal
121.5 MHz Homing	112	1	Yes
Delta Latitude +/-	113	1	Default
Delta Latitude Minutes	114-118	00000	Default
Delta Latitude Seconds	119-122	1111	Default
Delta Longitude +/-	123	1	Default
Delta Longitude Minutes	124-128	00000	Default
Delta Longitude Seconds	129-132	1111	Default
BCH Code (12 Bit)	133-144	011001101100	011001101100
Calculated BCH Code (12 Bit)	-	011001101100	011001101100

Frequency Plot



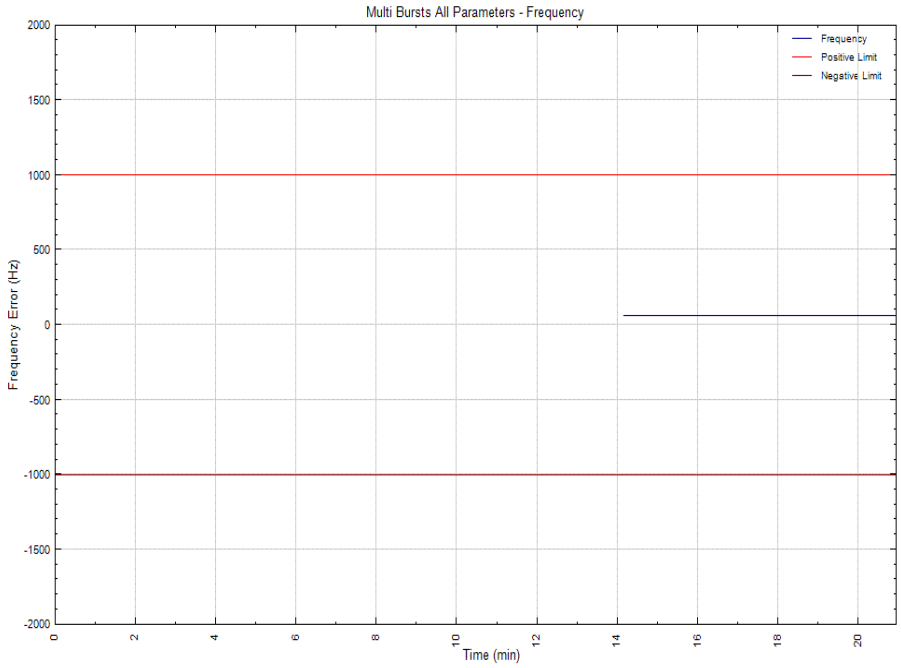
Modulation Plot



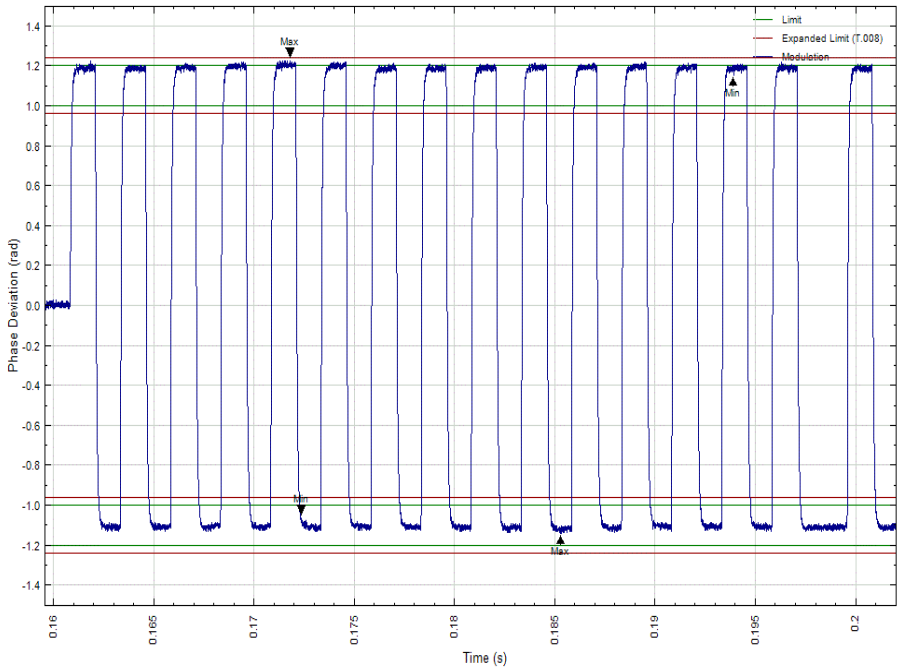
High Temperature

Message	FFFE2F8C97F9C0637FDFFF11B23783E0F66C		
Hex ID	192FF380C6FFBFF		
Position	None - Default Values		
Parameter	Bit	Data Bits	Decoded Value
Bit synchronization	1-15	111111111111111	111111111111111
Frame synchronization	16-24	000101111	000101111
Format Flag	25	1	1
Protocol Flag	26	0	0
Country Code	27-36	0011001001	Albania (Republic of)
Protocol Code	37-40	0111	Standard Location Protocol - PLB-serial
C/S TA No.	41-50	1111100111	1111100111
Serial Number	51-64	00000001100011	99
N/S	65	0	Default
Latitude Degrees	66-72	1111111	Default
Latitude Minutes	73-74	11	Default
E/W	75	0	Default
Longitude Degrees	76-83	11111111	Default
Longitude Minutes	84-85	11	Default
BCH Code (21 Bit)	86-106	11100010001101100 1000	11100010001101100 1000
Calculated BCH Code (21 Bit)	-	11100010001101100 1000	11100010001101100 1000
Supplementary Data Fixed	107-110	1101	1101
Encoded Position Data Source	111	1	Internal
121.5 MHz Homing	112	1	Yes
Delta Latitude +/-	113	1	Default
Delta Latitude Minutes	114-118	00000	Default
Delta Latitude Seconds	119-122	1111	Default
Delta Longitude +/-	123	1	Default
Delta Longitude Minutes	124-128	00000	Default
Delta Longitude Seconds	129-132	1111	Default
BCH Code (12 Bit)	133-144	011001101100	011001101100
Calculated BCH Code (12 Bit)	-	011001101100	011001101100

Frequency Plot



Modulation Plot (Worst Case)



Summary

The EUT fails to comply* with clause A.3.3 of Cospas-Sarsat T.007.

* 406MHz VSWR Check – Phase Deviation (Maximum Positive and Maximum Negative at +55°C): outside the limits stated in C/S T.007. However, the results are within the Test Facility Accuracy figure stated in C/S T.008.

.

2.7 SELF-TEST MODES

2.7.1 Specification

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

2.7.2 Equipment Under Test and Modification State

ResQlink (PLB 425) S/N: 7 C/S - Modification State 0 (Self-Test Mode)
ResQlink (PLB 425) S/N: 7 C/S - Modification State 1 (GNSS Self-Test Mode)
ResQlink (PLB 425) S/N: 7 C/S - Modification State 2 (PIE Test)

2.7.3 Date of Test

18 September 2018, 24 September 2018, 25 September 2018 & 01 November 2018

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 20.8 - 24.8°C
Relative Humidity 36.1 - 46.2%

2.7.6 Test Results

Self-test Mode

Ambient Temperature

Message	FFFED08C97F9C0637FDFFF11B237		
Hex ID	192FF380C6FFBFF		
Position	None - Default Values		
Parameter	Bit	Data Bits	Decoded Value
Bit synchronization	1-15	111111111111111	111111111111111
Frame synchronization	16-24	011010000	011010000
Format Flag	25	1	1
Protocol Flag	26	0	0
Country Code	27-36	0011001001	Albania (Republic of)
Protocol Code	37-40	0111	Standard Location Protocol - PLB-serial
C/S TA No.	41-50	1111100111	1111100111
Serial Number	51-64	00000001100011	99
N/S	65	0	Default
Latitude Degrees	66-72	1111111	Default
Latitude Minutes	73-74	11	Default
E/W	75	0	Default
Longitude Degrees	76-83	11111111	Default
Longitude Minutes	84-85	11	Default
BCH Code (21 Bit)	86-106	111000100011011001000	111000100011011001000
Calculated BCH Code (21 Bit)	-	111000100011011001000	111000100011011001000
Supplementary Data Fixed	107-110	1101	1101
Encoded Position Data Source	111	1	Internal
121.5 MHz Homing	112	1	Yes

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

Low Temperature

Message	FFFED08C97F9C0637FDFFF11B237		
Hex ID	192FF380C6FFBFF		
Position	None - Default Values		
Parameter	Bit	Data Bits	Decoded Value
Bit synchronization	1-15	111111111111111	111111111111111
Frame synchronization	16-24	011010000	011010000
Format Flag	25	1	1
Protocol Flag	26	0	0
Country Code	27-36	0011001001	Albania (Republic of)
Protocol Code	37-40	0111	Standard Location Protocol - PLB-serial
C/S TA No.	41-50	1111100111	1111100111
Serial Number	51-64	00000001100011	99
N/S	65	0	Default
Latitude Degrees	66-72	1111111	Default
Latitude Minutes	73-74	11	Default
E/W	75	0	Default
Longitude Degrees	76-83	11111111	Default
Longitude Minutes	84-85	11	Default
BCH Code (21 Bit)	86-106	111000100011011001000	111000100011011001000
Calculated BCH Code (21 Bit)	-	111000100011011001000	111000100011011001000
Supplementary Data Fixed	107-110	1101	1101
Encoded Position Data Source	111	1	Internal
121.5 MHz Homing	112	1	Yes

High Temperature

Message	FFFED08C97F9C0637FDFFF11B237		
Hex ID	192FF380C6FFBFF		
Position	None - Default Values		
Parameter	Bit	Data Bits	Decoded Value
Bit synchronization	1-15	111111111111111	111111111111111
Frame synchronization	16-24	011010000	011010000
Format Flag	25	1	1
Protocol Flag	26	0	0
Country Code	27-36	0011001001	Albania (Republic of)
Protocol Code	37-40	0111	Standard Location Protocol - PLB-serial
C/S TA No.	41-50	1111100111	1111100111
Serial Number	51-64	00000001100011	99
N/S	65	0	Default
Latitude Degrees	66-72	1111111	Default
Latitude Minutes	73-74	11	Default
E/W	75	0	Default
Longitude Degrees	76-83	11111111	Default
Longitude Minutes	84-85	11	Default
BCH Code (21 Bit)	86-106	111000100011011001000	111000100011011001000
Calculated BCH Code (21 Bit)	-	111000100011011001000	111000100011011001000
Supplementary Data Fixed	107-110	1101	1101
Encoded Position Data Source	111	1	Internal
121.5 MHz Homing	112	1	Yes

Table F-E.3: Self-test Mode Actions and Indications

No.	Action/Indication	Time-stamp (HH:MM:SS)	Description of action/indication	Duration of action/indication (sec)	Notes
1	Self-Test mode initiation (distinct action)	00:00:00	Press and Hold 'T' test button	4	Self-Test initiated by pressing the 'T' button for greater than 2 but less than 5 seconds.
2	Distinct indication of the Self-test initiation	00:00:02	Green LED flash	1	
3	Self-test single burst transmission	00:00:05			Verified by TUV test system.
4	Self-test message default values	00:00:05			Verified by TUV test system.
5	Distinct indication of RF transmission	00:00:05	Green LED Flash	0.5	406 and 121 bursts transmitted.
6	Distinct indication of the Self-test PASS result	00:00:07	2 x Green LED flash Followed by Strobe light flash	0.5 + 1 1	EUT LCD will also display 'Self-Test' PASS message for 5 seconds. Proceed to step 10.
7	Distinct indication of the Self-test FAIL result	00:00:07	2 x Red LED flash	0.5 + 1	EUT LCD will also display 'Self-Test' FAIL message, followed by 'Battery Low' (if applicable) for 5 seconds. Proceed to step 10.
8	Distinct indication of Insufficient Battery Energy	00:00:08	Low battery indicator (if applicable)	4	EUT LCD will display 'Low Battery' warning.
9	Automatic termination of the Self-test mode, irrespectively of the switch position	00:00:12			If the 'T' button is held for longer than 5 seconds, the EUT will enter GNSS Self-Test mode. See Table F.E-4 for further details.
10	Duration of the Self-test mode	00:00:12	All visual/audible indicators cease		

GNSS Self-test mode

General

All duration measurements below include activation method time, i.e. they start from test switch press and include any “hold for x seconds” requirement and they end when all visual and audible activity appeared to cease.

All positional accuracy values below were calculated using the Haversine Formula; the Earth’s radius was taken as 6367 km.

GNSS Self-Test Observations

Parameter	Actual	Declared
GNSS Self-test count	20	20
GNSS Self-test maximum duration (s) incl. activation method	102	110
Indication of GNSS Self-test activation/completion	A GNSS self-test activation is activated by holding the Test button until the Green LED flashes rapidly for 1 second. The Red LED will flash once every 5 seconds until either: navigation data is detected – the Green LED will flash twice, followed by a single strobe flash. The EUT will transmit a single 406 burst containing the appropriate navigation data. All activity will then cease. or no navigation data is detected – the EUT will transmit a single 406 burst containing default navigation data. All activity will then cease.	
Indication of GNSS Self-test count limit reached	The red LED will flash three times and the EUT LCD will display text stating that the GNSS Self-Test limit has been reached. All activity will then cease.	

Summary: GNSS Self-test with Valid Navigation Input

Protocol	Standard Location Protocol		
Temperature (°C)	-20	+22	+55
Frame sync verification	011010000	011010000	011010000
Format Flag (1 bit)	1	1	1
Single Radiated burst (ms)	521.00	520.91	520.95
Position data	P	P	P
Single burst verification	P	P	P
Actual duration (s) incl. activation method	60	57	54
Position Input Latitude	N 51° 22' 35"		
Position Input Longitude	W 001° 49' 50"		
Position Output Latitude	N 51° 22' 36"	N 51° 22' 36"	N 51° 22' 36"
Position Output Longitude	W 001° 49' 52"	W 001° 49' 52"	W 001° 49' 52"
Position Error (m)	49.3	49.3	49.3

Protocol	National Location Protocol		
Temperature (°C)	-20	+22	+55
Frame sync verification	011010000	011010000	011010000
Format Flag (1 bit)	1	1	1
Single Radiated burst (ms)	521.04	520.90	520.93
Position data	P	P	P
Single burst verification	P	P	P
Actual duration (s) incl. activation method	53	57	59
Position Input Latitude	N 51° 22' 35"		
Position Input Longitude	W 001° 49' 50"		
Position Output Latitude	N 51° 22' 36"	N 51° 22' 36"	N 51° 22' 36"
Position Output Longitude	W 001° 49' 52"	W 001° 49' 52"	W 001° 49' 52"
Position Error (m)	49.3	49.3	49.3

Summary: GNSS Self-test without Valid Navigation Input

Protocol	Standard Location Protocol		
Temperature (°C)	-20	+22	+55
Frame sync verification	011010000	011010000	011010000
Format Flag (1 bit)	1	1	1
Single Radiated burst (ms)	520.99	520.90	520.97
Default Position data	P	P	P
Single burst verification	P	P	P
Actual duration (s) incl. activation method	102	102	102

Protocol	National Location Protocol		
Temperature (°C)	-20	+22	+55
Frame sync verification	011010000	011010000	011010000
Format Flag (1 bit)	1	1	1
Single Radiated burst (ms)	521.03	520.90	520.96
Default Position data	P	P	P
Single burst verification	P	P	P
Actual duration (s) incl. activation method	102	102	102

Full Hex Messages	
National Location Protocol with Navigation data applied	
+55°C	FFFED08C9F0018CCD701C85E1A379208025B
Ambient	FFFED08C9F0018CCD701C85E1A379208025B
-20°C	FFFED08C9F0018CCD701C85E1A379208025B
National Location Protocol without Navigation data applied	
+55°C	FFFED08C9F0018DFC0FF04F9E4379F3C0010
Ambient	FFFED08C9F0018DFC0FF04F9E4379F3C0010
-20°C	FFFED08C9F0018DFC0FF04F9E4379F3C0010
Standard Location Protocol with Navigation data applied	
+55°C	FFFED08C9EF9C06333A03ECA66771DA4D4D0
Ambient	FFFED08C9EF9C06333A03ECA66771DA4D4D0
-20°C	FFFED08C9EF9C06333A03ECA66771DA4D4D0
Standard Location Protocol without Navigation data applied	
+55°C	FFFED08C9EF9C0637FDFF83D15B783E0F66C
Ambient	FFFED08C9EF9C0637FDFF83D15B783E0F66C
-20°C	FFFED08C9EF9C0637FDFF83D15B783E0F66C

Table F-E.4: GNSS Self-Test Mode Actions and Indications

No.	Action/Indication	Time-stamp (HH:MM:SS)	Description of action/indication	Duration of action/indication (sec)	Notes
1	GNSS Self-test mode initiation (distinct action)	00:00:00	Press and Hold 'T' test button	5	GNSS Self-Test initiated by pressing the 'T' button for a minimum of 5 seconds.
2	Distinct indication of the GNSS Self-test initiation	00:00:05	3 x Green LED flash		Red LED will flash once every 5 seconds until the end of the test.
3	GNSS Self-test single burst transmission	00:01:38			Verified by TUV test system.
4	GNSS Self-test message position encoding	00:01:38			Verified by TUV test system.
5	Distinct indication of the GNSS Self-test PASS result	< 00:01:42	2 x Green LED flash Followed by Strobe light flash	0.5 + 1 1	EUT LCD will also display the encoded position, followed by 'GPS test' PASS message followed by 'xx tests remaining' for 10 seconds total. Proceed to step 9.
6	Distinct indication of the GNSS Self-test FAIL result	00:01:38	Single Red LED flash	4	EUT LCD will also display 'GPS Test' FAIL message, followed by 'xx tests remaining'. Proceed to step 9.
7	Distinct indication that the manufacturer-declared limited number of GNSS Self-tests is attained	00:00:06	3 x Red LED flash, followed by LCD message 'GPS test limit reached! No GPS tests remaining'.	4	All visual/audible indicators cease after 10 seconds.
8	Automatic termination of the Self-test mode, irrespectively of the switch position				See note below
9	Duration of the GNSS Self-test mode	00:01:42	All visual/audible indicators cease		

Note: If the 'T' button is continuously held in the on position, the EUT Green LED will flash rapidly after 15 seconds. If the 'T' button is then released*, the EUT LCD will show that the EUT has entered 'programming mode'. With no further action and approximately 50 seconds after the initial activation, the LCD will display 'Programming failed'. All visual/audible indicators will cease after 54 seconds, and the EUT will return to standby (off) mode and no further current will be drawn.

* If the 'T' button is continuously held at this point, there will be no further indicators from the EUT and it will return to standby (off) after approximately 30 seconds.

See battery current plots for further information.

Table F.E-5: Testing Insufficient Battery Energy

Parameter	Units	Declared by beacon manufacturer	Verified and evaluated by accepted test facility	Notes
Minimum duration of continuous operation (C_{CO})	hours	24	Manufacturer declared value	C_{CO} is declared in Annex G as "Operating Lifetime". C_{CO} is required for the test. Minimum duration of continuous operation (C_{CO})
Full Battery Pack Capacity **(C_{BP})**	hours	33	Manufacturer declared value	If needed to calculate $C_{SP\text{-}AMB}$
Battery Pre-Operational Losses **(C_{PO})**	hours	3.91	Manufacturer declared value	Corresponds to L_{CDC}, as defined in the Table F-E.2
Spare Battery Capacity at ambient temperature **($C_{SP\text{-}AMB}$)**	hours	5.09	Manufacturer declared value	$C_{SP\text{-}AMB}$ is required for the test, and shall be defined by testing (see Footnote 4 to section A.3.6.2.2), or by calculation, as follows: **$C_{SP\text{-}AMB} = C_{BP} – (C_{PO} + C_{CO})$**
Criteria and conditions to trigger **PIE** indication		Note 1		Description of PIE criteria and conditions to be met to trigger PIE indication. Use a separate sheet if needed
Step-1: battery pack discharge	hours	-	2.0 – 0.5 = 1.5	Battery discharge shall correspond to: **C_{PO} - 30 minutes,** or the value declared by the beacon manufacturer less 30 minutes
Step-1: beacon conditions (if applicable)		-	EUT operated in A4* mode with no GPS data present	Description of conditions recreated during the Step-1 for which the PIE criteria is not met
Step-1: observations of self-test indication		-	Self-Test: EUT LCD indication 'PASS'	Test facility observations of self-test indication: time, duration, type of indication
Step-2: battery pack discharge	hours	-	2.0 (declared) + 0.5 = 2.5	Total battery discharge shall correspond to: **C_{PO} + $C_{SP\text{-}AMB}$ + 30 minutes** or the value declared by the beacon manufacturer plus 30 minutes
Step-2: beacon conditions (if applicable)	-	-	EUT operated in A4* mode with no GPS data present	Description of conditions recreated during the Step-2 for which the PIE criteria is met
Step-2: observations of distinct PIE indication		-	Self-Test: EUT LCD indication 'FAIL – Battery Low'	Test facility observations of PIE indication: time, duration, type of indication

Note 1. Duration of Self-Test, GNSS Self-Test, operation of beacon is added for a total time. When this total exceeds 2 hours the user is alerted when performing self-test.

Summary

The EUT complies with clause A.3.6 of Cospas-Sarsat T.007.

2.8 THERMAL SHOCK

2.8.1 Specification

Cospas-Sarsat T.007, Clause A.2.2

2.8.2 Equipment Under Test and Modification State

ResQlink (PLB 425) S/N: 3 RTCM - Modification State 0

2.8.3 Date of Test

19 September 2018

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

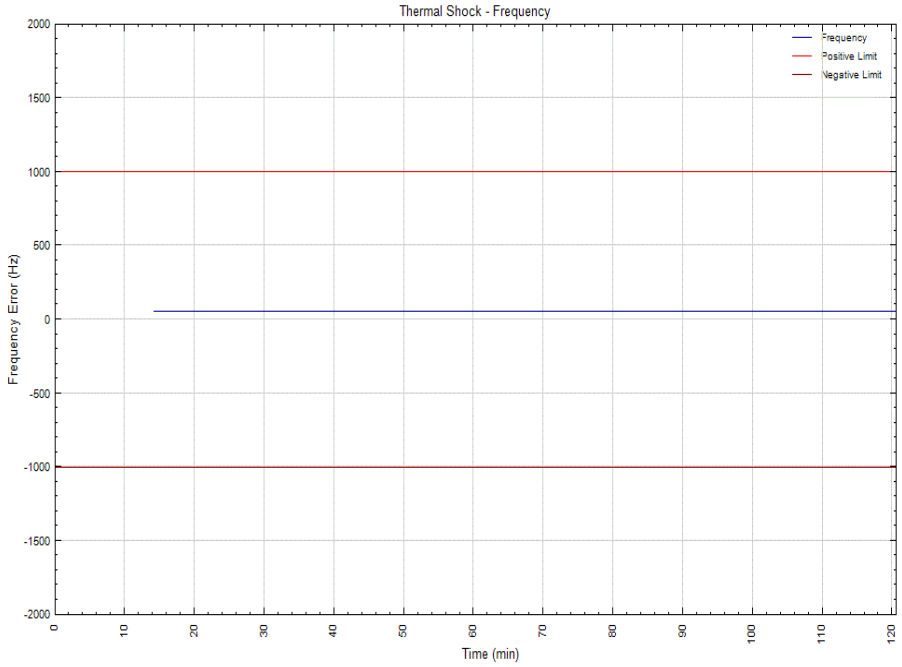
Ambient Temperature 22.5°C
Relative Humidity 47.1%

2.8.6 Test Results

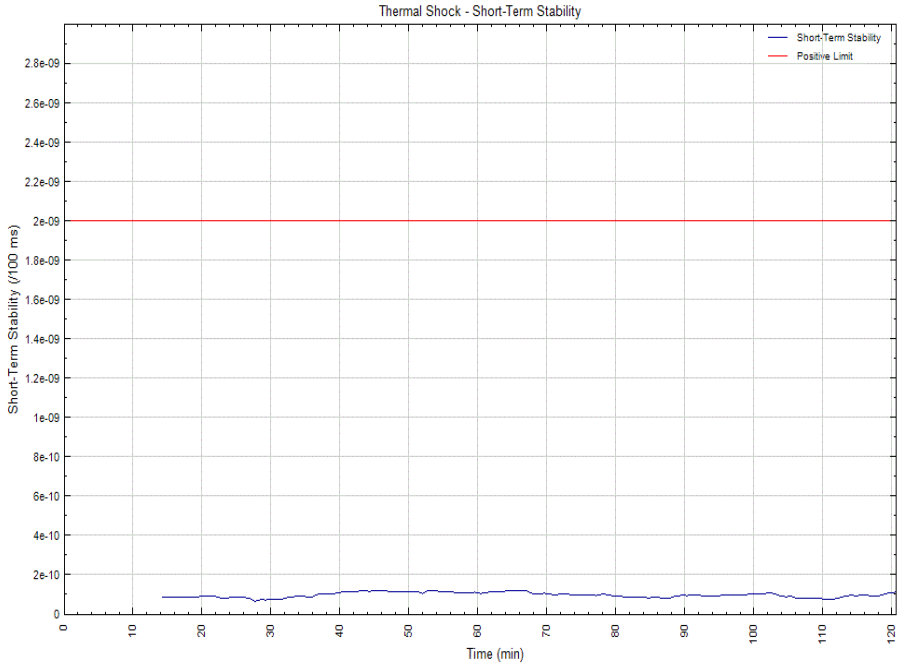
Soak Temperature: 20.0°C

Test Tempearture: -10.0°C

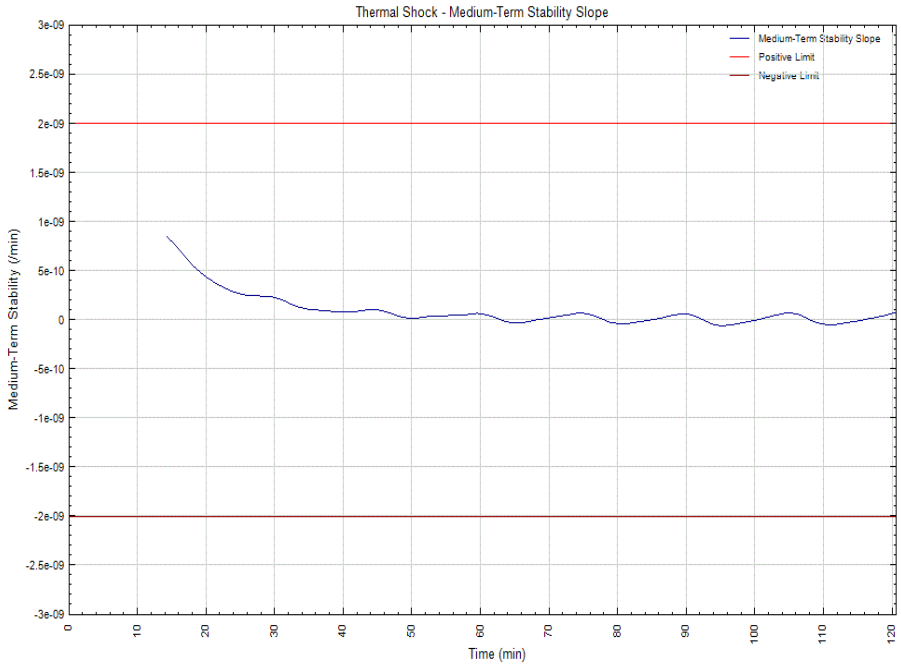
Nominal Frequency



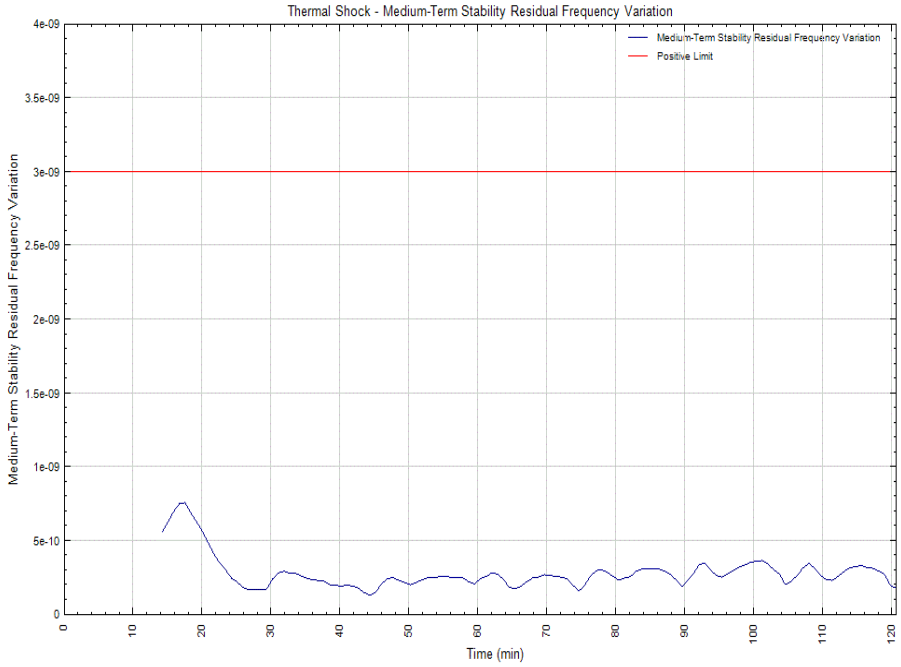
Short Term Stability



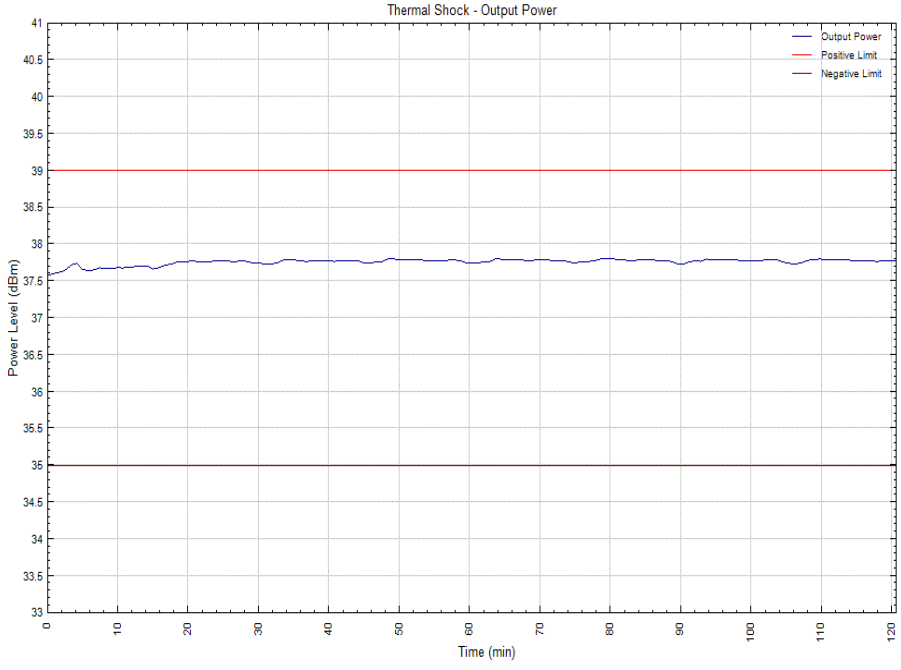
Medium Term Stability, Mean Slope



Medium Term Stability, Residual Frequency Variation



Output Power



Digital Message

Message	FFFE2F8C97F9C0637FDFFF11B23783E0F66C		
Hex ID	192FF380C6FFBFF		
Position	None - Default Values		
Parameter	Bit	Data Bits	Decoded Value
Bit synchronization	1-15	111111111111111	111111111111111
Frame synchronization	16-24	000101111	000101111
Format Flag	25	1	1
Protocol Flag	26	0	0
Country Code	27-36	0011001001	Albania (Republic of)
Protocol Code	37-40	0111	Standard Location Protocol - PLB-serial
C/S TA No.	41-50	1111100111	1111100111
Serial Number	51-64	00000001100011	99
N/S	65	0	Default
Latitude Degrees	66-72	1111111	Default
Latitude Minutes	73-74	11	Default
E/W	75	0	Default
Longitude Degrees	76-83	11111111	Default
Longitude Minutes	84-85	11	Default
BCH Code (21 Bit)	86-106	11100010001101100 1000	11100010001101100 1000
Calculated BCH Code (21 Bit)	-	11100010001101100 1000	11100010001101100 1000
Supplementary Data Fixed	107-110	1101	1101
Encoded Position Data Source	111	1	Internal
121.5 MHz Homing	112	1	Yes
Delta Latitude +/-	113	1	Default
Delta Latitude Minutes	114-118	00000	Default
Delta Latitude Seconds	119-122	1111	Default
Delta Longitude +/-	123	1	Default
Delta Longitude Minutes	124-128	00000	Default
Delta Longitude Seconds	129-132	1111	Default
BCH Code (12 Bit)	133-144	011001101100	011001101100
Calculated BCH Code (12 Bit)	-	011001101100	011001101100

Summary

The EUT complies with clause A.2.2 of Cospas-Sarsat T.007.

2.9 OPERATING LIFETIME AT MINIMUM TEMPERATURE

2.9.1 Specification

Cospas-Sarsat T.007, Clause A.2.3

2.9.2 Equipment Under Test and Modification State

Model: PLB-425, S/N: 3 RTCM, TUV Ref: TSR4 and Modification State 0 (Lifetime Test)
Model: PLB-425, S/N: 11 C/S, TUV Ref: TSR2 and Modification State 0 (Battery Current Measurements)
Model: PLB-425, S/N: 11 C/S, TUV Ref: TSR2 and Modification State 2 (Battery Current Measurement comparison)

2.9.3 Date of Test

22 September 2018 (Modification State 0 measurements)
22 October 2018 (Modification State 2 measurements)

2.9.4 Test Equipment Used

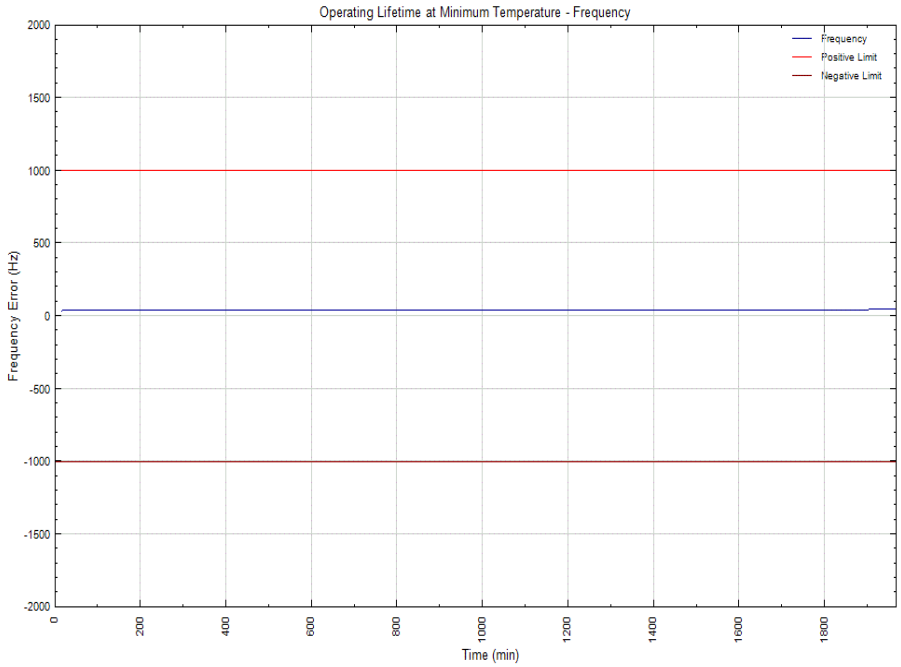
The major items of test equipment used for the above tests are identified in Section 3.1.

2.9.5 Environmental Conditions

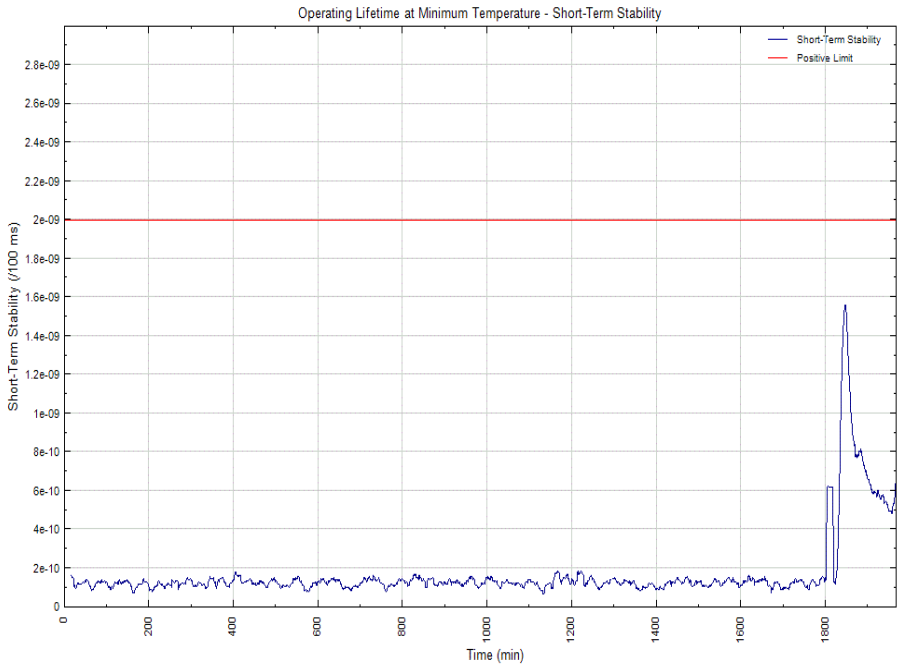
Ambient Temperature 21.0°C
Relative Humidity 44.6%

2.9.6 Test Results

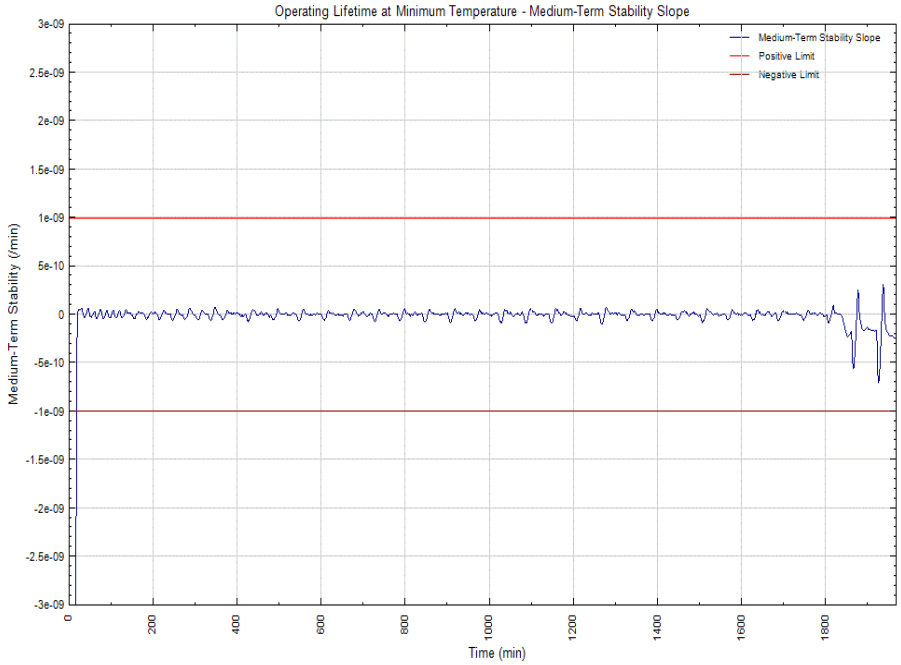
Nominal Frequency



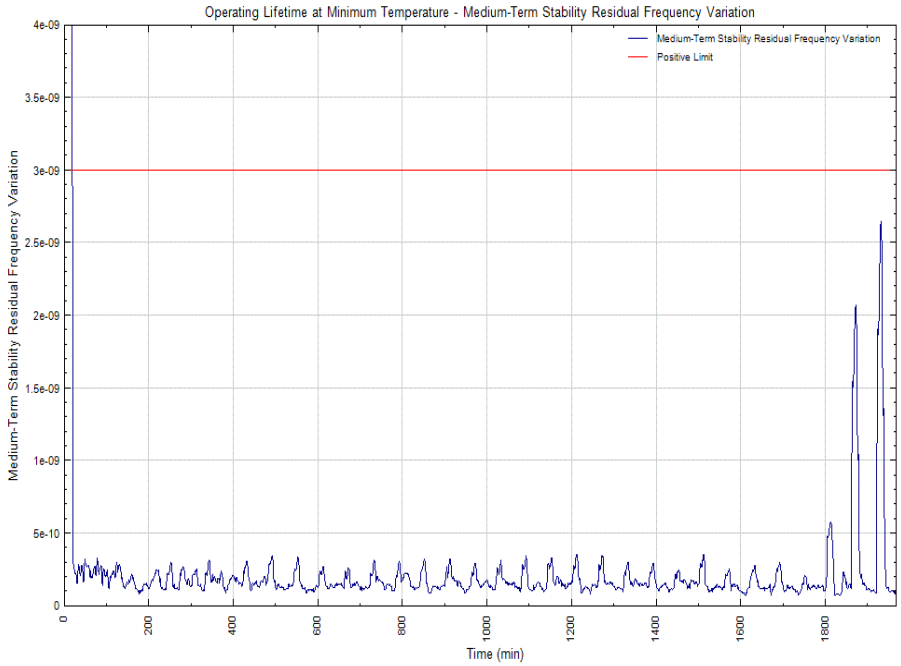
Short Term Stability



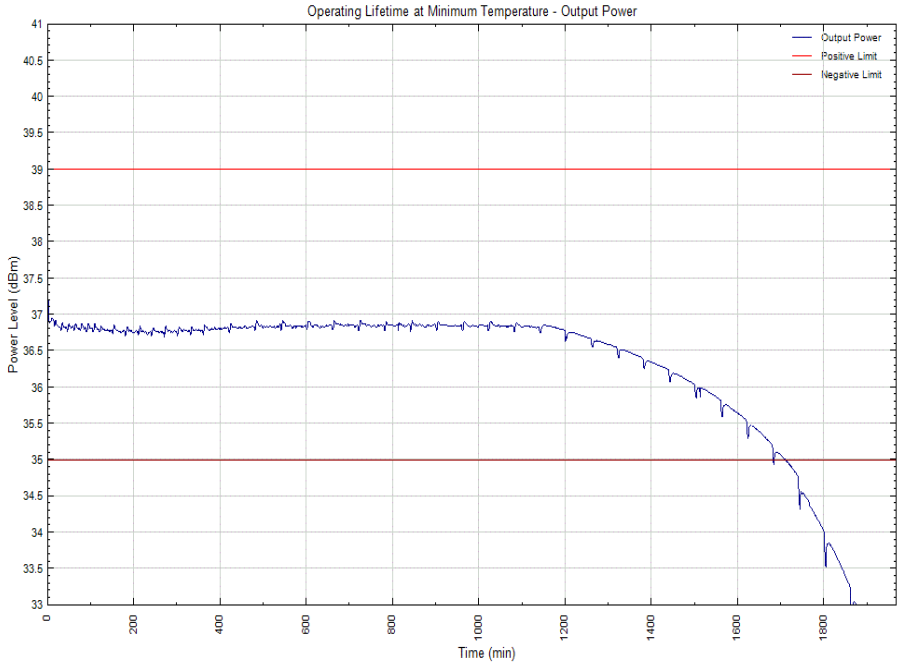
Medium Term Stability, Mean Slope



Medium Term Stability, Residual Frequency Variation



Output Power



Digital Message

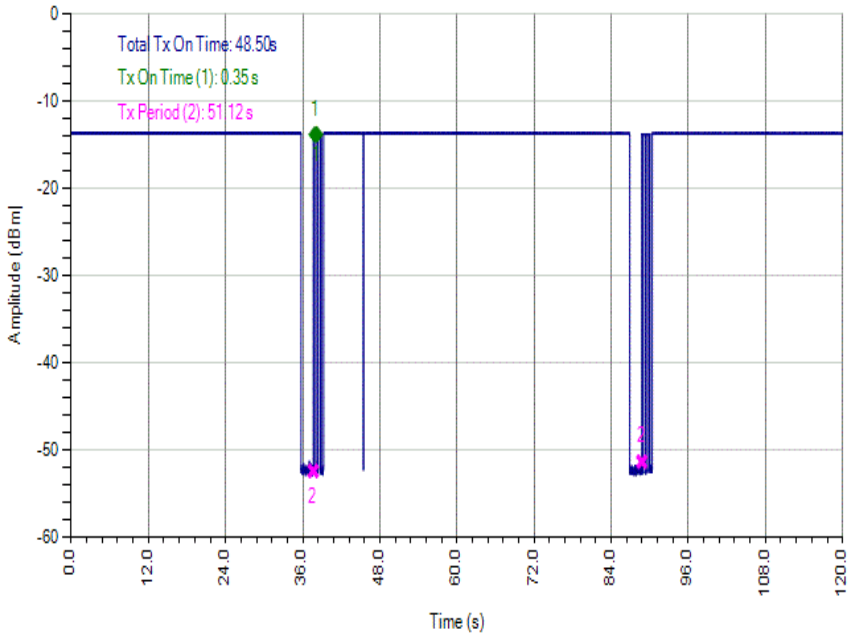
Message	FFFE2F8C97F9C0637FDFFF11B23783E0F66C		
Hex ID	192FF380C6FFBFF		
Position	None - Default Values		
Parameter	Bit	Data Bits	Decoded Value
Bit synchronization	1-15	111111111111111	111111111111111
Frame synchronization	16-24	000101111	000101111
Format Flag	25	1	1
Protocol Flag	26	0	0
Country Code	27-36	0011001001	Albania (Republic of)
Protocol Code	37-40	0111	Standard Location Protocol - PLB-serial
C/S TA No.	41-50	1111100111	1111100111
Serial Number	51-64	00000001100011	99
N/S	65	0	Default
Latitude Degrees	66-72	1111111	Default
Latitude Minutes	73-74	11	Default
E/W	75	0	Default
Longitude Degrees	76-83	11111111	Default
Longitude Minutes	84-85	11	Default
BCH Code (21 Bit)	86-106	111000100011011001000	111000100011011001000
Calculated BCH Code (21 Bit)	-	111000100011011001000	111000100011011001000
Supplementary Data Fixed	107-110	1101	1101
Encoded Position Data Source	111	1	Internal
121.5 MHz Homing	112	1	Yes
Delta Latitude +/-	113	1	Default
Delta Latitude Minutes	114-118	00000	Default
Delta Latitude Seconds	119-122	1111	Default
Delta Longitude +/-	123	1	Default
Delta Longitude Minutes	124-128	00000	Default
Delta Longitude Seconds	129-132	1111	Default
BCH Code (12 Bit)	133-144	011001101100	011001101100
Calculated BCH Code (12 Bit)	-	011001101100	011001101100

Test Data (0 min - 30 min)

#	Output Power (dBm)	Nominal Frequency (Hz)	Short Term Stability (/100 ms)	Medium Term Stability – Slope (/min)	Medium Term Stability – RFV (no units)	Time (h)
1	37.46	-	-	-	-	0.000
2	37.26	-	-	-	-	0.014
3	36.95	-	-	-	-	0.028
4	36.92	-	-	-	-	0.042
5	36.9	-	-	-	-	0.056
6	36.9	-	-	-	-	0.070
7	36.89	-	-	-	-	0.083
8	36.9	-	-	-	-	0.098
9	36.9	-	-	-	-	0.111
10	36.91	-	-	-	-	0.125
11	36.93	-	-	-	-	0.139
12	36.96	-	-	-	-	0.153
13	36.96	-	-	-	-	0.166
14	36.95	-	-	-	-	0.180
15	36.94	-	-	-	-	0.193
16	36.93	-	-	-	-	0.208
17	36.92	-	-	-	-	0.221
18	36.91	406.0309651	1.612E-10	-5.408E-09	1.513E-08	0.235
19	36.84	406.0309633	1.613E-10	-4.318E-09	1.443E-08	0.249
20	36.84	406.0309617	1.630E-10	-3.235E-09	1.290E-08	0.263
21	36.85	406.0309603	1.599E-10	-2.231E-09	1.076E-08	0.276
22	36.88	406.0309591	1.517E-10	-1.321E-09	7.790E-09	0.290
23	36.92	406.0309583	1.529E-10	-5.923E-10	4.388E-09	0.304
24	36.92	406.0309578	1.480E-10	-1.537E-10	1.410E-09	0.318
25	36.88	406.0309577	1.501E-10	-1.087E-11	4.767E-10	0.332
26	36.87	406.0309576	1.477E-10	2.532E-11	2.985E-10	0.345
27	36.86	406.0309576	1.462E-10	3.808E-11	2.720E-10	0.359
28	36.85	406.0309576	1.135E-10	4.914E-11	2.506E-10	0.372
29	36.84	406.0309577	1.041E-10	5.786E-11	2.509E-10	0.386
30	36.84	406.0309577	1.119E-10	5.496E-11	2.403E-10	0.401
31	36.84	406.0309577	9.772E-11	4.933E-11	2.290E-10	0.414
32	36.83	406.0309577	9.775E-11	4.643E-11	2.206E-10	0.428
33	36.83	406.0309578	9.612E-11	4.813E-11	2.238E-10	0.443
34	36.83	406.0309578	9.712E-11	5.640E-11	2.139E-10	0.457
35	36.82	406.0309578	1.014E-10	5.838E-11	2.123E-10	0.471
36	36.83	406.0309578	1.057E-10	6.790E-11	1.556E-10	0.485
37	36.78	406.0309578	1.187E-10	6.815E-11	1.543E-10	0.498
38	36.78	406.0309578	1.223E-10	5.729E-11	2.073E-10	0.512

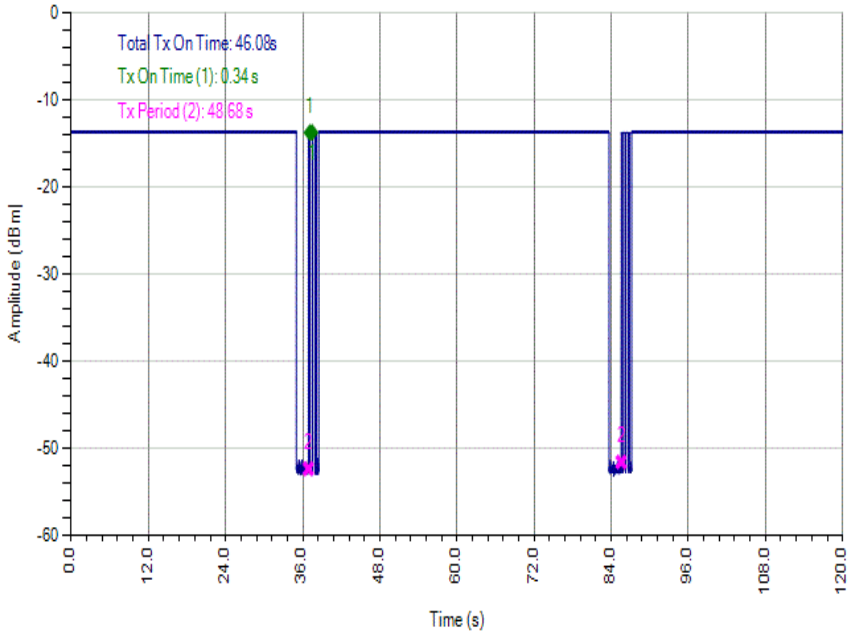
Results outside of the specification are marked in red text.

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



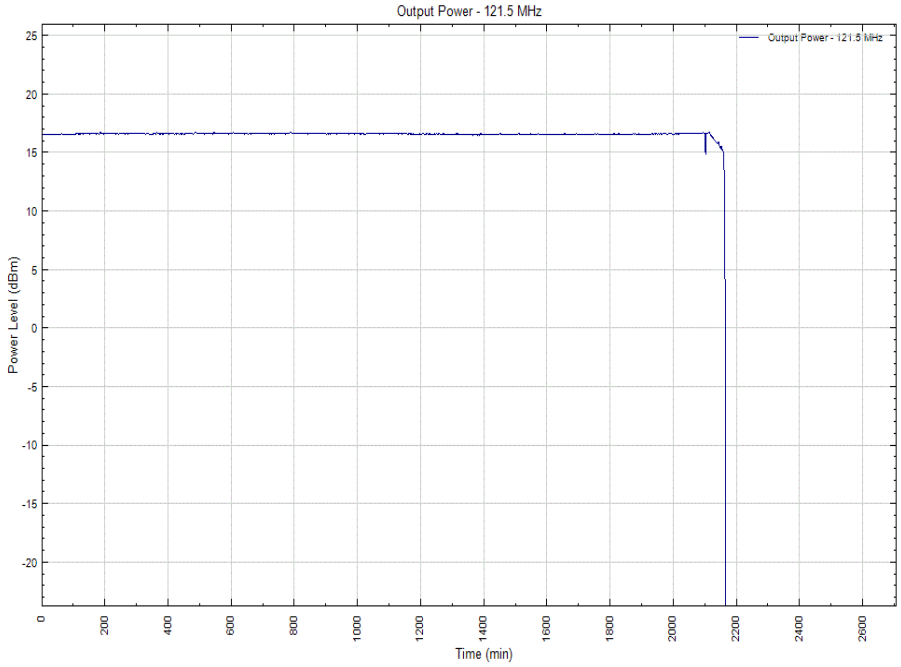
Duty Cycle = 48.5 / (48.5+2.6) = 94.8%

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

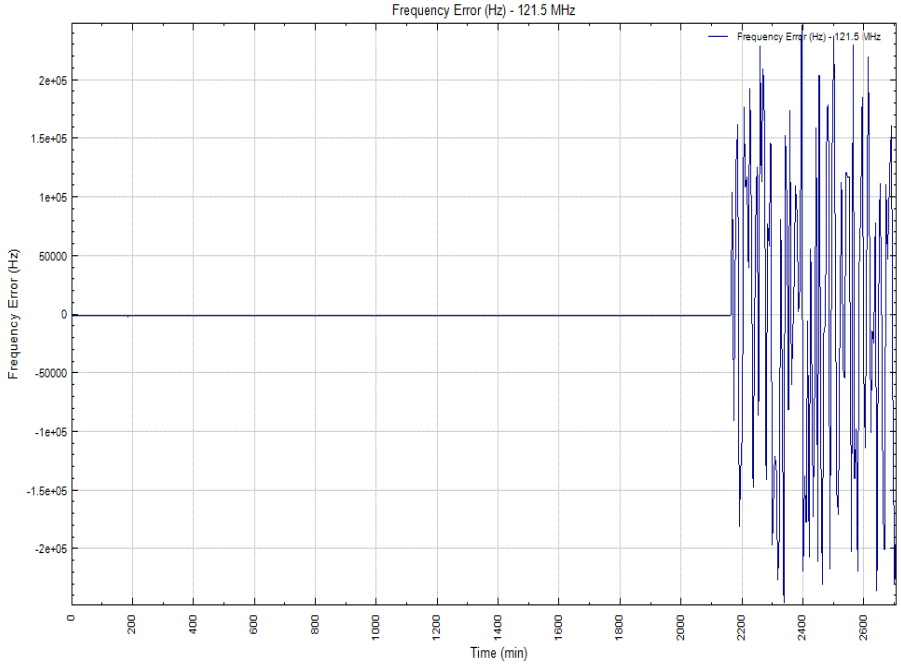


Duty Cycle = 46.08 / (46.08+2.6) = 94.7%

121MHz Homing Transmitter Power



121MHz Homing Transmitter Frequency



Summary

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

Operating Current Measurements and Analysis

System Configurations and Operating Modes Modification State 0

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

* GNSS Self-Test (timeout) is considered the worst case, as the EUT transmits a 406MHz burst with default data at the end of the test.

Beacon Operating Modes	Mode: Manually selectable or Automatic	Measurement interval, sec	Average Current, mA	Peak Current, mA
A1	A	599.9	3.005E-06	3.93E-06
A2	M	221.4	53.19	1901
A3	M	221.3	36.4	1887
A4	M	442.7	44.79	1901
A5	M	13.9	75.77	1334
A6	M	107.4	26.15	1341
A7	M	54.4	21.33	27.64

The sampling interval was a nominal 80 ms for all measurements.

Worst Case System Configurations / Operating Modes

"Lifetime in service" drains (highest average current):
Standby: A1
Self-test: A5
GNSS Self-test (Timeout): A6

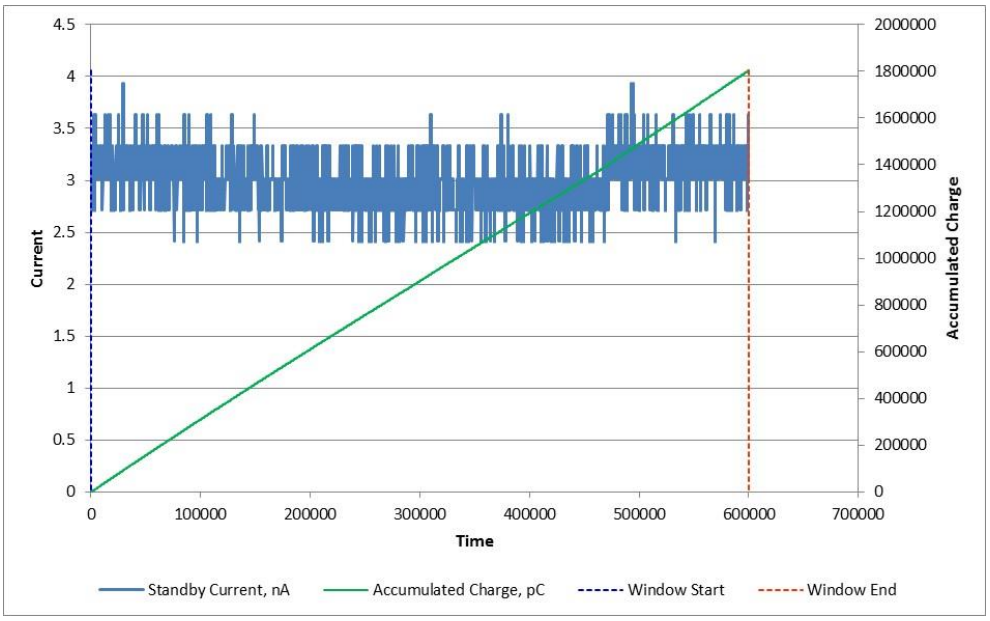
Note: "Worst case" GNSS Self-test is a test which times out because a long message is transmitted regardless of acquisition.

Operating mode used for battery conditioning calculations (equal or lower average current than mode used for conditioning)
A3 – ON at EUT (GPS Sleep)

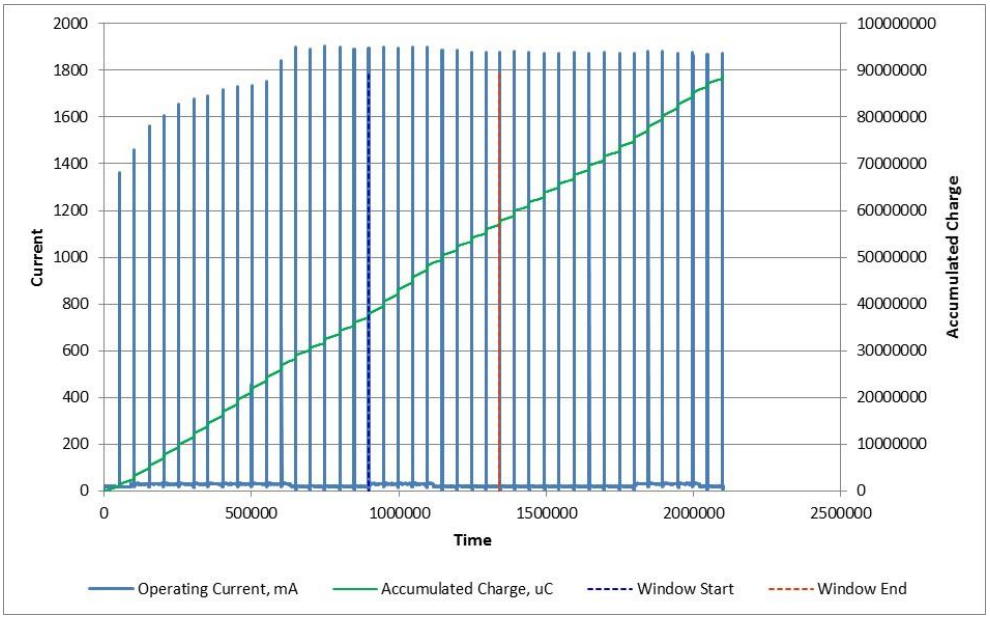
Operating mode used for actual battery conditioning (equal or higher average current than mode used for calculations):
A4 – ON at EUT, GPS Search / GPS Off in normal operating duty cycle
Conditions during battery conditioning:
Temperature: Ambient
GNSS Signals: None applied

Operating mode during lifetime test (highest average current):
A4 – ON at EUT, GPS Search / GPS Off in normal operating duty cycle
Conditions during lifetime test:
GNSS Signals: None applied

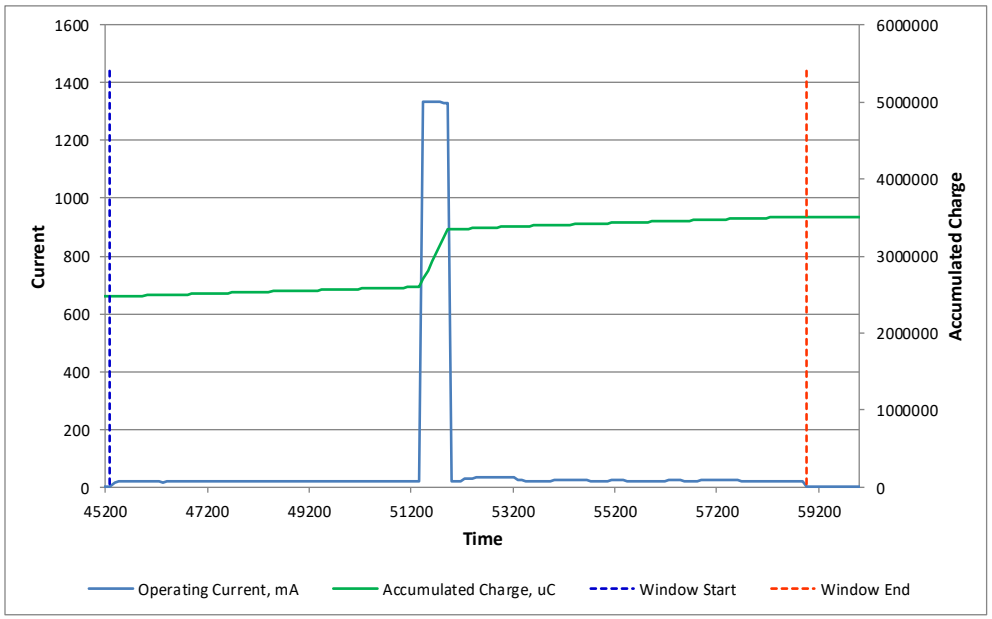
Current Measurement Plots



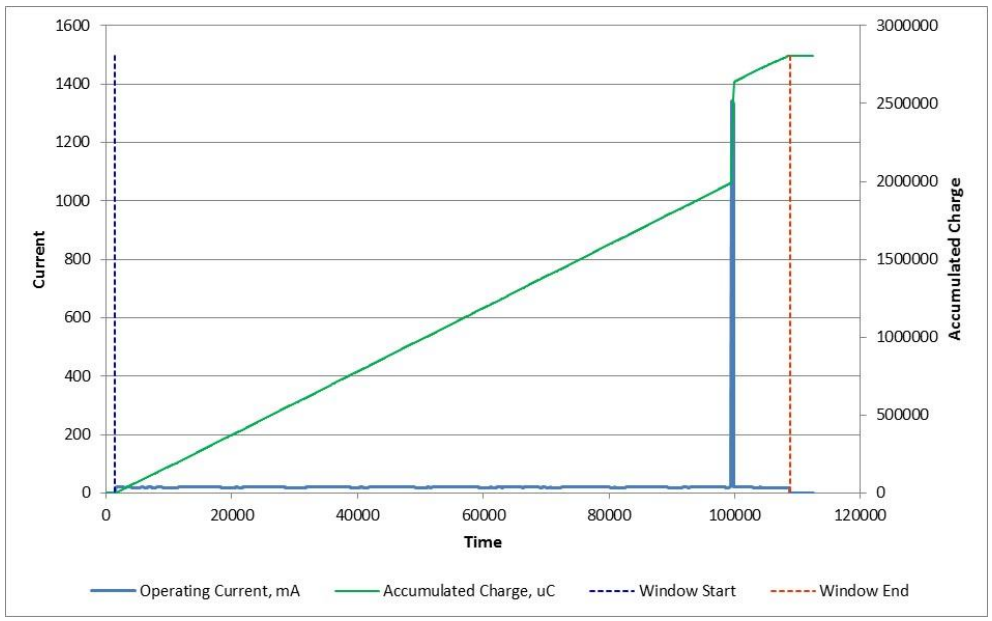
Standby: A1



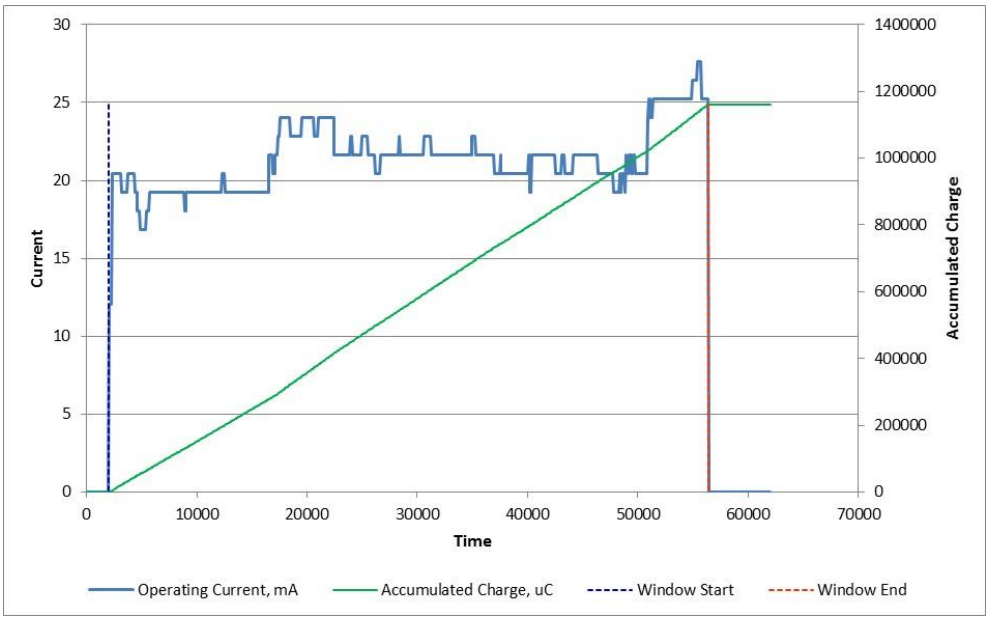
Operating: A4



Self-test: A5

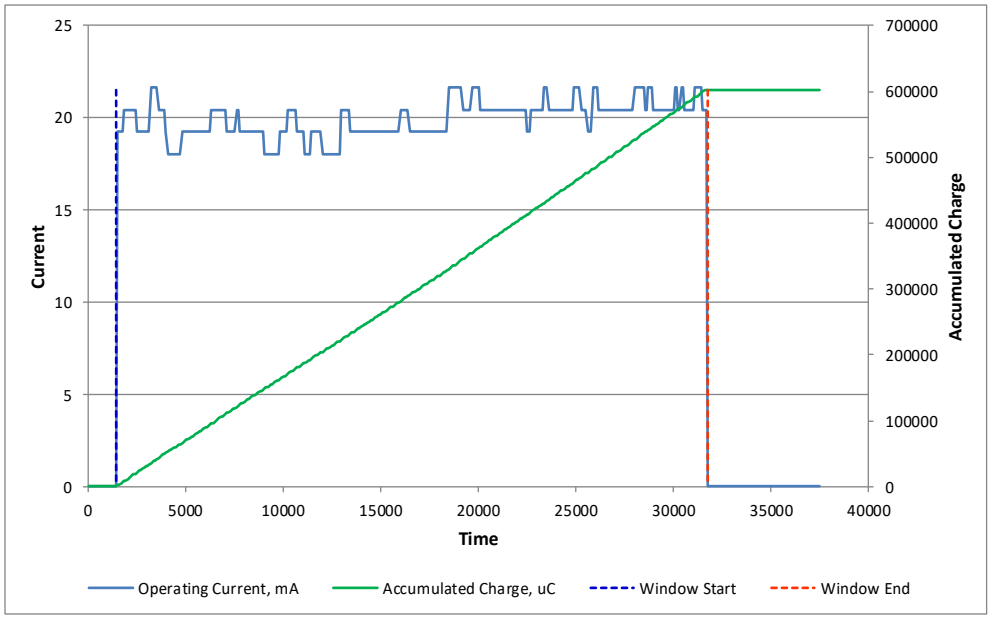


GNSS Self-test (Timeout): A6



Programme Mode: A7

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



Self-Test button continuously held in the ‘On’ position

Product Service

Battery Conditioning Calculations

As per C/S T.007 Table F-E.2:

Characteristic	Designation	Units	Value	Comments
Beacon manufacturers declared maximum allowed cell shelf-life (from date of cell manufacture to date of battery pack installation in the beacon)	T_{CS} or TCS	Years	1	
Declared beacon battery replacement period (from date of installation in the beacon to expiry date marked on the beacon)	T_{BR} or TBR	Years	5	
Battery pack electrical configuration	-	-		
Cell model and cell chemistry	-	-		
Nominal cell capacity	-	Ah	1.4	
Nominal battery pack capacity	C_{BN}	Ah	1.4	
Annual battery cell capacity loss (self-discharge) due to aging, as specified by cell manufacturer at ambient temperature	L_{SDC}	%	1	
Calculated battery pack capacity loss due to self-discharge: $L_{CBN} = C_{BN} - [C_{BN} * (1 - L_{SDC} / 100)^{TBR+TCS}]$	L_{CBN}	Ah	0.0819	
Number of self-tests per year	N_{ST}	-	12	
Average battery current during a self-test	I_{ST}	mA	75.77	
Maximum duration of a self-test	T_{ST}	s	14	Manufacturer Declared Value
Calculated battery pack capacity loss due to self-tests during battery replacement period: $L_{ST} = I_{ST} * T_{ST} * T_{BR} * (N_{ST} / 3600)$	L_{ST}	mAh	17.68	
Maximum Number of GNSS self-tests between battery replacements	N_{GST}	-	20	
Average battery current during a GNSS self-test of maximum duration	I_{GST}	mA	26.15	
Maximum duration of a GNSS self-test	T_{GST}	s	110	Manufacturer Declared Value
Calculated battery pack capacity loss due to GNSS self-tests during battery replacement period: $L_{GST} = I_{GST} * T_{GST} * (N_{GST} / 3600)$	L_{GST}	mAh	15.98055556	
Average stand-by battery pack current	I_{SB}	mA	0.000003	
Other Capacity Losses	L_{OTH}	mAh	3.2	See Note below
Battery pack capacity loss due to constant operation of circuitry prior to beacon activation: $L_{ISB} = I_{SB} * T_{BR} * 8760$	L_{ISB}	mAh	0.1314	
Calculated value of the battery pack pre-test discharge $L_{CDC} = L_{CBN} + 1.65((L_{ST} + L_{GST} + L_{ISB})/1000) + (L_{OTH}/1000)$	L_{CDC}	Ah	0.1409	

Battery Discharge Calculations

Characteristic	Designation	Units	Value	Comments
Method of discharge	-	-		
Discharge current	L_D	mA	36.4	Worst Case (lowest current) Mode A3
Discharge duration, $T_D = L_{CDC} / (L_D * 1000)$	T_D	h	3.86	Actual Discharge 4.5 hours Mode A4

Note: If the end user inadvertently enters programming mode (by holding the TEST button for >15s <20s**), the EUT will draw current for approximately 54 seconds before powering down with no further action (see manufacturer documentation for further details).
The average current during this time was measured as 21.33mA. This equates to 0.32mAh. The manufacturer has declared that this feature can only be accessed a maximum of 10 times - any further attempts cause no action from the EUT. Therefore, the overall maximum current drain = 0.32mAh * 10 attempts = 3.2mAh
** This is the worst case scenario - if the Test button is continuously held, the EUT will power down earlier, thereby drawing less overall current. See battery current measurement plots for details.

Battery Conditioning Results

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

Pre-test discharge (L_{CDC}) [mAh]	=	140.9
Operating mode current [mA]	=	36.4
Pre-test discharge duration [h]	=	140.9 / 36.4
Pre-test discharge duration [h]	=	3.86

The actual discharge duration was 4.5 h resulting in a discharge of 163.8 mAh; an over-test of 16.2 %.

Operating Current Measurements and Analysis

System Configurations and Operating Modes Modification State 2

Note: Battery Current measurements were repeated in Modification State 2 to demonstrate that any alterations to the EUT did not adversely affect the operating current. Measurements are presented below:

System Configuration → **Operational Mode ↓**	A, No Ancillaries
1, Standby	**A1**
2, ON at EUT switch (GPS Search)	**A2**
3, ON at EUT (GPS Sleep)	**A3**
3, ON at EUT (Average A2+A3)	**A4**
5, Self-test	**A5**
6, GNSS Self-test (Timeout)*	**A6**
7, Programme Mode	**A7**

* GNSS Self-Test (timeout) is considered the worst case, as the EUT transmits a 406MHz burst with default data at the end of the test.

Beacon Operating Modes	Mode: Manually selectable or Automatic	Measurement interval, sec	Average Current, mA	Peak Current, mA
A1	A	599.9	0.0000006509	0.0000124
A2	M	221.8	47.33	1549
A3	M	221.8	37.02	1540
A4	M	443.5	42.38	1549
A5	M	13.8	74.77	1387
A6	M	106.4	26.2	1401
A7	M	57.3	21.35	21.63

The sampling interval was a nominal 80 ms for all measurements.

Battery Current Comparison Measurements

The table below show battery current comparison measurements made between Modification States 0 and 2:

Operating Mode	Modification State 0	Modification State 2	% Difference
	Average Current (mA)	Average Current (mA)	Mod State 2 to 0
1, Standby	0.000003005	0.0000006509	-78.34
2, ON at EUT switch (GPS Search)	53.19	47.33	-11.02
3, ON at EUT (GPS Sleep)	36.4	37.02	1.70
3, ON at EUT (Average)	44.79	42.38	-5.38
5, Self-test	75.77	74.77	-1.3
6, GNSS Self-test	26.15	26.2	0.19
7, Programme Mode*	21.33	21.35	0.09

* The 'Test' button was released once the EUT entered programming mode.

Observations/Notes:

Cospas Sarsat expressed a concern over the comparison results shown above for operating mode 2 (ON at EUT switch (GPS Search)), which exhibited a 11% difference when Modification State 0 is compared to Modification State 2.
Measurements were repeated on the same EUT in both Modification States[#] and are presented in Annex B.

[#] The manufacturer reverted the EUT back to Modification State 0 to enable repeat measurements.

2.10 FREQUENCY STABILITY TEST WITH TEMPERATURE GRADIENT

2.10.1 Specification

Cospas-Sarsat T.007, Clause A.2.4

2.10.2 Equipment Under Test and Modification State

ResQlink (PLB 425) S/N: 3 RTCM - Modification State 0

2.10.3 Date of Test

20 September 2018

2.10.4 Test Equipment Used

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

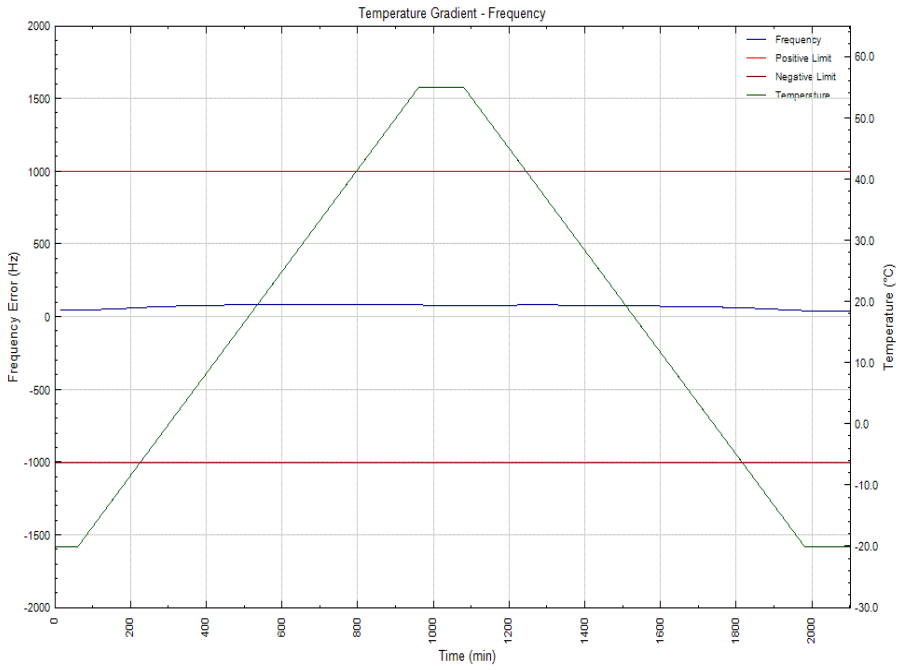
2.10.5 Environmental Conditions

Ambient Temperature 23.2°C
Relative Humidity 54.7%

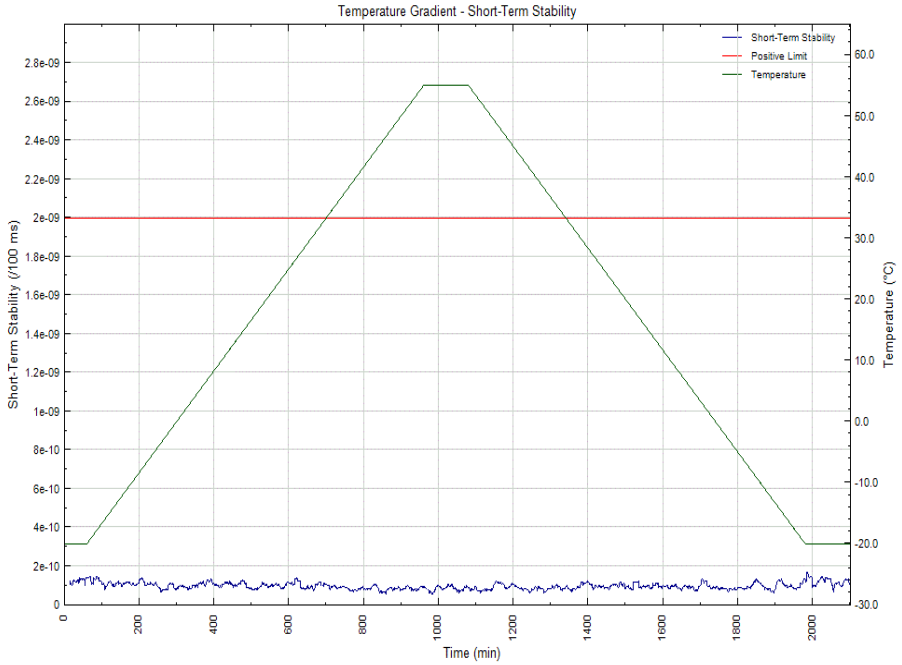
2.10.6 Test Results

Full Test

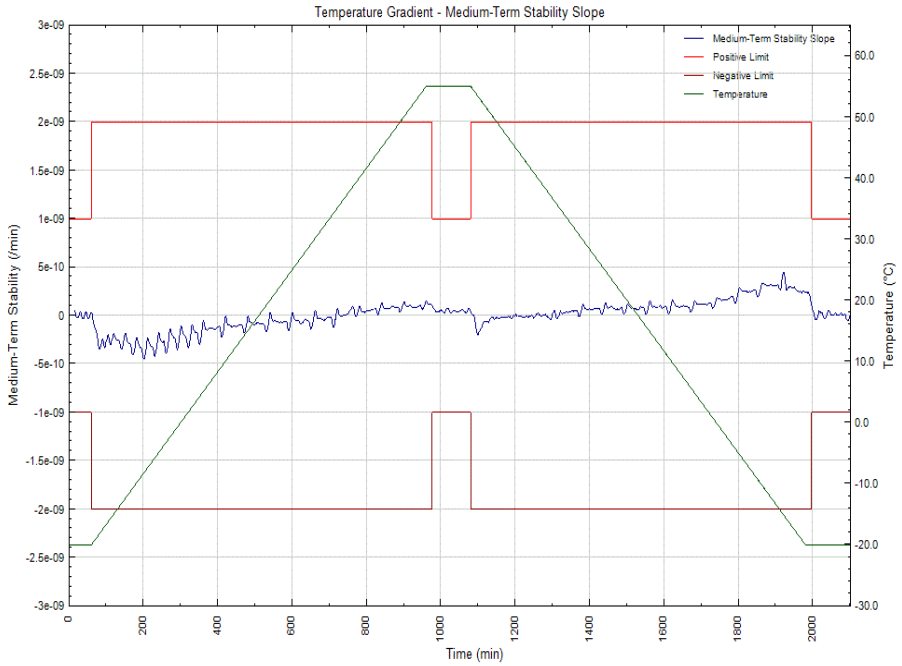
Nominal Frequency



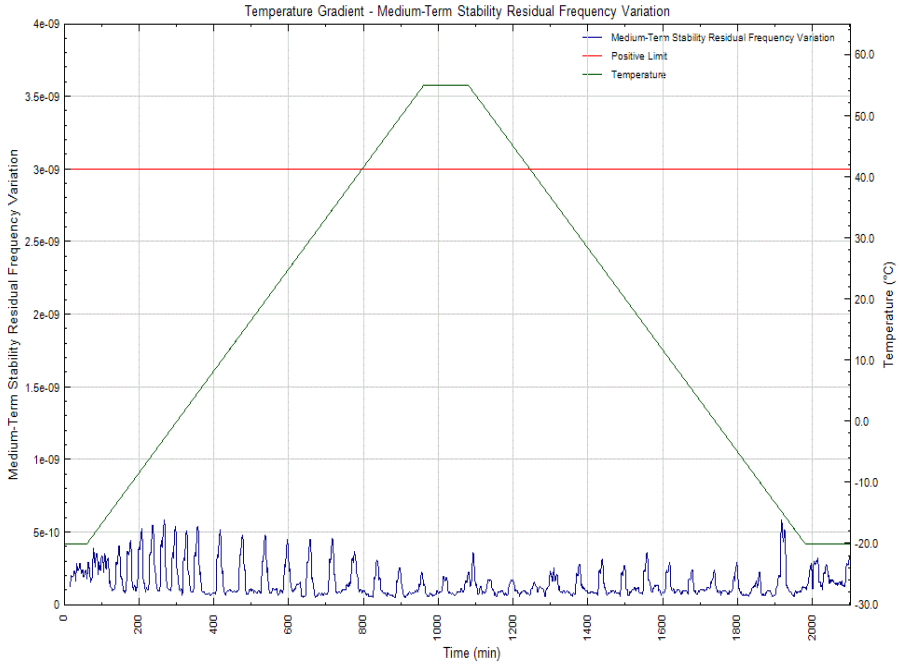
Short Term Stability



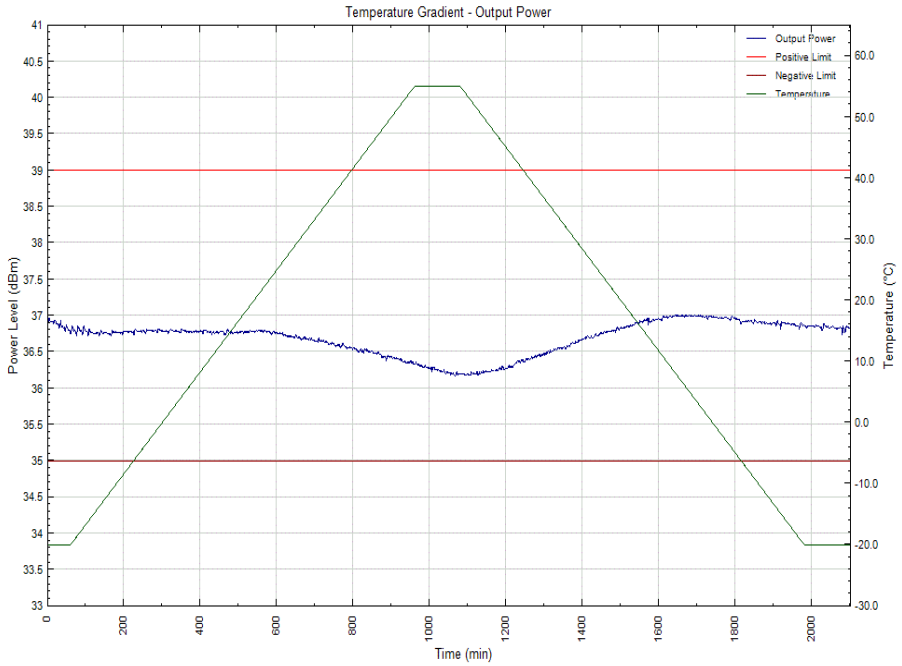
Medium Term Stability, Mean Slope



Medium Term Stability, Residual Frequency Variation



Output Power



Digital Message

Message	FFFE2F8C97F9C0637FDFFF11B23783E0F66C		
Hex ID	192FF380C6FFBFF		
Position	None - Default Values		
Parameter	Bit	Data Bits	Decoded Value
Bit synchronization	1-15	111111111111111	111111111111111
Frame synchronization	16-24	000101111	000101111
Format Flag	25	1	1
Protocol Flag	26	0	0
Country Code	27-36	0011001001	Albania (Republic of)
Protocol Code	37-40	0111	Standard Location Protocol - PLB-serial
C/S TA No.	41-50	1111100111	1111100111
Serial Number	51-64	00000001100011	99
N/S	65	0	Default
Latitude Degrees	66-72	1111111	Default
Latitude Minutes	73-74	11	Default
E/W	75	0	Default
Longitude Degrees	76-83	11111111	Default
Longitude Minutes	84-85	11	Default
BCH Code (21 Bit)	86-106	11100010001101100 1000	11100010001101100 1000
Calculated BCH Code (21 Bit)	-	11100010001101100 1000	11100010001101100 1000
Supplementary Data Fixed	107-110	1101	1101
Encoded Position Data Source	111	1	Internal
121.5 MHz Homing	112	1	Yes
Delta Latitude +/-	113	1	Default
Delta Latitude Minutes	114-118	00000	Default
Delta Latitude Seconds	119-122	1111	Default
Delta Longitude +/-	123	1	Default
Delta Longitude Minutes	124-128	00000	Default
Delta Longitude Seconds	129-132	1111	Default
BCH Code (12 Bit)	133-144	011001101100	011001101100
Calculated BCH Code (12 Bit)	-	011001101100	011001101100

Interim TCXO Procedure

TCXO Model: E6907

TCXO S/No: 599

MTS Characteristic	Time (h)	Temp. (°C)	tot	osc	beacon_wc	MAX-OSC	beacon_max	Ageing factor	beacon_5 year	Limit	Result
Residual	31.95	-14.0	5.894E-10	7.363E-11	5.848E-10	2.00E-09	2.084E-09	2.00E-10	2.284E-09	3.0E-09	Pass
Static Positive Mean Slope	33.26	-20.0	1.078E-10	3.241E-11	1.028E-10	7.00E-10	7.075E-10	1.00E-10	8.075E-10	1.0E-09	Pass
Static Negative Mean Slope	34.91	-20.0	-5.154E-11	5.653E-11	-7.650E-11	-7.00E-10	-7.042E-10	-1.00E-10	-8.042E-10	-1.0E-09	Pass
Gradient Positive Mean Slope	32.02	-14.3	4.528E-10	-3.310E-11	4.540E-10	1.70E-09	1.760E-09	1.00E-10	1.860E-09	2.0E-09	Pass
Gradient Negative Mean Slope	3.35	-8.4	-4.497E-10	-9.473E-12	-4.496E-10	-1.70E-09	-1.758E-09	-1.00E-10	-1.858E-09	-2.0E-09	Pass

Summary

The EUT complies with clause A.2.4 of Cospas-Sarsat T.007.

2.11 SATELLITE QUALITATIVE TESTS

2.11.1 Specification

Cospas-Sarsat T.007, Clause A.2.5

2.11.2 Equipment Under Test and Modification State

ResQlink (PLB 425) S/N: 7 C/S - Modification State 1 (Configuration 7)
ResQlink (PLB 425) S/N: 7 C/S - Modification State 2 (Configuration 8)

2.11.3 Date of Test

27 September 2018 – 28 September 2018
30 October 2018 – 31 October 2018

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 9 – 25.4°C
Relative Humidity 33.2 – 67.7%

2.11.6 Test Results

Configuration 7

Test Start: 15:00 27/09/18
Test End: 10:00 28/09/18
15 Hex ID: 193E0 031BF 81FE0

Actual location of the test beacon: 50.814333
(Daedalus Airfield, Lee-on-the-Solent, Central) -1.2017389

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)
S11	61958	193E0 031BF 81FE0	50.81822	-1.19539	-128.69	22:38:28	-18.685	0.621
S13	31273	193E0 031BF 81FE0	50.81852	-1.19714	-134.48	21:59:22	-11.000	0.566
S11	61957	193E0 031BF 81FE0	50.82160	-1.19866	-127.90	20:57:21	-2.727	0.836
S13	31272	193E0 031BF 81FE0	50.82065	-1.21773	-129.56	20:18:58	4.615	1.324
S10	68827	193E0 031BF 81FE0	50.83022	-1.19361	-129.11	20:04:22	-5.877	1.855
S11	61956	193E0 031BF 81FE0	50.81998	-1.21489	-129.39	19:17:41	12.056	1.116
S7	5964	193E0 031BF 81FE0	50.82634	-1.19156	-127.75	19:02:04	-9.027	1.514
S13	31271	193E0 031BF 81FE0	50.81963	-1.18661	-135.59	18:39:58	18.132	1.214
S10	68826	193E0 031BF 81FE0	50.83169	-1.21654	-129.56	18:23:51	9.299	2.191
S12	49665	193E0 031BF 81FE0	50.81727	-1.19098	-131.14	17:37:42	-18.985	0.823
S7	5963	193E0 031BF 81FE0	50.82802	-1.21158	-129.08	17:22:10	6.378	1.671
S12	49664	193E0 031BF 81FE0	50.81992	-1.19101	-127.73	15:55:58	-2.937	0.976
S7	5962	193E0 031BF 81FE0	50.82742	-1.22743	-133.83	15:43:39	19.484	2.317
S10	68834	193E0 031BF 81FE0	50.80130	-1.20898	-129.17	08:21:00	-5.633	1.535
S12	49673	193E0 031BF 81FE0	50.82030	-1.19662	-126.35	07:32:39	19.821	0.754
S7	5971	193E0 031BF 81FE0	50.80808	-1.21754	-128.56	07:11:44	-3.030	1.309
S12	49672	193E0 031BF 81FE0	50.81096	-1.20582	-128.12	05:53:18	6.823	0.472
S7	5970	193E0 031BF 81FE0	50.82117	-1.21683	-137.40	05:30:55	-18.941	1.304
S12	49671	193E0 031BF 81FE0	50.80864	-1.21071	-129.94	04:12:32	-8.635	0.893

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

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

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

$$= 100\%$$

Configuration 8

Test Start: 15:00 30/10/2018
Test End: 09:29 31/10/18
15 Hex ID: 193E0 031BF 81FE0

Actual location of the test beacon: 50.814305
(Daedalus Airfield, Lee-on-the-Solent, Central) -1.2017598

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	6435	193E0 031BF 81FE0	50.81136	-1.20108	-121.13	20:15:35	-20.317	0.331
S13	31742	193E0 031BF 81FE0	50.81703	-1.18838	-130.05	22:16:40	-13.747	0.987
S11	62426	193E0 031BF 81FE0	50.81796	-1.19303	-124.76	21:13:26	-5.450	0.735
S13	31741	193E0 031BF 81FE0	50.82260	-1.21079	-125.38	20:36:02	2.041	1.119
S10	69293	193E0 031BF 81FE0	50.82888	-1.19082	-123.57	20:21:36	-7.900	1.793
S10	69292	193E0 031BF 81FE0	50.81862	-1.20749	-113.43	18:40:54	7.495	0.626
S10	69291	193E0 031BF 81FE0	50.81734	-1.20995	-119.70	17:01:36	20.338	0.667
S11	62425	193E0 031BF 81FE0	50.82299	-1.20569	-125.52	19:33:31	9.662	1.004
S13	31740	193E0 031BF 81FE0	50.81888	-1.22244	-129.90	18:56:48	16.070	1.538
S7	6434	193E0 031BF 81FE0	50.82040	-1.19873	-124.47	18:34:38	-4.392	0.710
S7	6433	193E0 031BF 81FE0	50.82260	-1.22052	-126.27	16:55:08	10.537	1.608
S12	50130	193E0 031BF 81FE0	50.82321	-1.19769	-124.56	16:15:36	-5.272	1.030
S11	62433	193E0 031BF 81FE0	50.80837	-1.20766	-125.47	09:25:19	-5.982	0.779
S13	31748	193E0 031BF 81FE0	50.80566	-1.21554	-128.58	08:47:35	-13.818	1.364
S10	69300	193E0 031BF 81FE0	50.80245	-1.21683	-124.79	08:38:07	-3.636	1.690
S7	6442	193E0 031BF 81FE0	50.81766	-1.19629	-112.48	08:24:05	7.638	0.535
S10	69299	193E0 031BF 81FE0	50.79099	-1.20099	-130.86	06:56:20	-19.694	2.591
S7	6441	193E0 031BF 81FE0	50.80435	-1.20944	-126.13	06:44:18	-7.639	1.231
S12	50138	193E0 031BF 81FE0	50.80919	-1.20106	-125.19	06:12:50	8.954	0.571
S12	50137	193E0 031BF 81FE0	51.21538	-1.77232	-122.95	04:32:11	-6.678	59.812

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

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

$$= \frac{19}{20}$$

$$= 95\%$$

Summary

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

2.12 BEACON ANTENNA TEST

2.12.1 Specification

Cospas-Sarsat T.007, Clause A.2.6

2.12.2 Equipment Under Test and Modification State

ResQlink (PLB 425) S/N: #15 - Modification State 0

2.12.3 Date of Test

05 July 2018

2.12.4 Test Equipment Used

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

2.12.5 Environmental Conditions

Ambient Temperature 25.4 - 29.9°C
Relative Humidity 41.3 - 53.8%

2.12.6 Test Results

Configuration3

Legend: ~~Strikeout~~ **Under-range** **Over-range** Vv-Vh < 10 dB

	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	37.9	1.3	40.5	3.9	41.5	4.8	36.5	-0.1	32.8	-3.8
30	37.7	1.1	40.4	3.8	41.8	5.2	36.7	0.0	33.3	-3.3
60	38.0	1.4	40.8	4.2	41.9	5.3	36.8	0.2	33.9	-2.7
90	38.1	1.5	40.4	3.8	41.8	5.2	36.9	0.3	33.9	-2.7
120	37.8	1.2	40.7	4.1	41.9	5.2	36.8	0.2	33.7	-2.9
150	37.7	1.1	40.7	4.1	41.9	5.2	36.6	-0.1	33.7	-2.9
180	37.6	1.0	40.5	3.9	41.7	5.0	36.3	-0.3	33.5	-3.1
210	37.6	1.0	40.5	3.9	41.7	5.0	36.2	-0.4	33.2	-3.5
240	37.4	0.8	40.6	4.0	41.8	5.1	35.9	-0.7	33.2	-3.4
270	37.3	0.7	40.8	4.2	42.1	5.4	36.3	-0.3	32.9	-3.7
300	37.6	1.0	40.9	4.3	41.9	5.2	36.2	-0.4	32.8	-3.9
330	37.8	1.2	40.7	4.1	41.7	5.1	36.3	-0.4	33.0	-3.6

	Elevation Angle (degrees)									
	10		20		30		40		50	
Azimuth Angle (Degrees)	Vv	Vh	Vv	Vh	Vv	Vh	Vv	Vh	Vv	Vh
0	110.0	88.0	112.2	93.6	112.4	94.0	106.3	92.6	101.2	79.0
30	109.8	89.9	112.1	93.3	112.8	93.8	106.4	93.5	101.7	79.0
60	110.1	90.4	112.5	93.2	112.9	93.8	106.5	94.3	102.3	81.1
90	110.2	90.3	112.1	93.7	112.8	93.7	106.6	94.6	102.3	79.1
120	109.9	90.4	112.4	93.5	112.8	94.3	106.5	93.8	102.1	72.9
150	109.8	90.4	112.4	93.3	112.8	94.2	106.3	92.9	102.1	83.3
180	109.7	89.4	112.2	93.5	112.6	94.8	106.2	88.3	101.9	83.2
210	109.7	88.4	112.2	93.2	112.6	94.8	106.1	87.8	101.5	84.5
240	109.5	86.7	112.3	93.0	112.7	94.9	105.8	85.1	101.5	86.1
270	109.4	86.7	112.5	93.1	113.0	94.7	106.2	87.1	101.2	86.3
300	109.7	87.3	112.6	93.1	112.8	94.3	106.1	89.4	101.1	84.1
330	109.9	89.4	112.4	93.1	112.7	93.9	106.1	89.6	101.3	85.8
Min (Vv-Vh)	19.4		18.5		17.8		12.0		14.9	

$EIRP_{LOSS} = Pt_{ambient} - Pt_{EOL} =$ 36.63 - 36.16 = 0.47 dB

$EIRP_{maxEOL} = Max[EIRP_{max}, (EIRP_{max} - EIRP_{LOSS})] =$ Max[42.1, 41.6]= 42.1 dBm

$EIRP_{minEOL} = Min[EIRP_{min}, (EIRP_{min} - EIRP_{LOSS})] =$ Min[32.8, 32.3]= 32.3 dBm

Configuration 4

Legend: ~~**Strikeout**~~ **Under-range** **Over-range** Vv-Vh < 10 dB

	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	37.0	0.4	36.4	-0.3	36.5	-0.2	34.4	-2.3	36.4	-0.2
90	36.9	0.3	36.3	-0.3	37.0	0.4	35.1	-1.5	37.1	0.5
180	37.2	0.5	37.4	0.7	38.8	2.1	37.9	1.2	39.5	2.9
270	36.8	0.1	37.1	0.5	38.3	1.7	37.6	0.9	39.2	2.6

$EIRP_{LOSS} = Pt_{ambient} - Pt_{EOL} =$ 36.63 - 36.16 = 0.47 dB

$EIRP_{maxEOL} = Max[EIRP_{max}, (EIRP_{max} - EIRP_{LOSS})] =$ Max[39.5, 39.1]= 39.5dBm

$EIRP_{minEOL} = Min[EIRP_{min}, (EIRP_{min} - EIRP_{LOSS})] =$ Min[34.4, 33.9]= 33.9dBm

Summary

The EUT complies with clause A.2.6 of Cospas-Sarsat T.007.

2.13 NAVIGATION SYSTEM TEST

2.13.1 Specification

Cospas-Sarsat T.007, Clause A.2.7

2.13.2 Equipment Under Test and Modification State

ResQlink (PLB 425) S/N: 3 RTCM - Modification State 2 (All National Location Protocol Tests)
ResQlink (PLB 425) S/N: 7 C/S - Modification State 0 (Standard Location Protocol A.3.8.2)
ResQlink (PLB 425) S/N: 3 RTCM - Modification State 1 (Standard Location Protocol A.3.8.1, A.3.8.6)
ResQlink (PLB 425) S/N: 3 RTCM - Modification State 2 (Standard Location Protocol A.3.8.3, A.3.8.4)

2.13.3 Date of Test

21 September 2018, 18 October 2018, 29 October 2018 & 06 November 2018

2.13.4 Test Equipment Used

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

2.13.5 Environmental Conditions

Ambient Temperature 14.8 - 21.5°C
Relative Humidity 37.4 – 81.4%

2.13.6 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° 52.121' N	1° 14.685'W	①
A.3.8.2.2:	50° 48.860'N	1° 12.104'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 7	52	35.6	52	24.2
Configuration 8	52	35.6	52	24.2

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

① GPS Site Survey – Live Location

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

Location: N 50° 48.683' W 1° 37.417' ①		
Data Acquired at	09:42:34	FFFE2F8C9F0018CCB1019D9B45F794240FCD
Location: N 51° 22.583' W 1° 49.833' ①		
Data Updated at	09:47:35	FFFE2F8C9F0018CCD701C85E1A379208025B
Data Update Interval	5 min 01 s	

① Input from GPS simulator

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

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

Locations: N 0° 00.000' E 0° 00.000' (Start location). The position changes by 20km every 4m 55s, moving in a NE direction (045 bearing). ①		
Parameter	Update interval	Limit
0 h to 2 h – Minimum	05:01	≥ 05:00
0 h to 2 h – Maximum	15:07	≤ 33:35*
2 h to 6 h – Minimum	29:54	≥ 05:00
2 h to 6 h – Maximum	30:14	≤ 33:35*
6 h to 24 h – Minimum	59:24	≥ 05:00
6 h to 24 h – Maximum	60:15	≤ 63:35*
Assessment	Result	
Results indicate that data changes as per C/S T.001 4.5.5.4 (Y/N)	Y	
Results indicate that data changes as per manufacturer's update scheme (Y/N)	Y	

① Input from GPS simulator

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

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

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

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

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

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

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

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

Location: N 51° 22.583' W 1° 49.833' ①		
Data Acquired at	10:03:53	FFFE2F8C9F0018CCD701C85E1A379208025B
GPS Signal Navigation Data Removed		
Last Message with Encoded Data	14:08:16	FFFE2F8C9F0018CCD701C85E1A379208025B
Data Updated at	14:09:05	FFFE2F8C9F0018DFC0FF04F9E4379F3C0010
Last Valid Position Held	244 min 23 s	
Return to Default Position	✓	

① Input from GPS simulator

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	36

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

Locations:

A.3.8.2.1:	50° 48.860' N	1° 12.104'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 7	51	35.6	51	24.2
Configuration 8	51	35.6	51	24.2

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

① GPS Site Survey – Live Location

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

Location: N 50° 48.683' W 1° 37.417' ①		
Data Acquired at	11:03:06	FFFE2F8C9E00000032E0335A3FF78EA76951
Location: N 51° 22.583' W 1° 49.833' ①		
Data Updated at	11:08:07	FFFE2F8C9E00000033A03C8E9EF71DA4D4D0
Data Update Interval	5 min 01 s	

① Input from GPS simulator

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

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

Locations: N 0° 00.000' E 0° 00.000' (Start location). The position changes by 20km every 4m 55s, moving in a NE direction (045 bearing). ①		
Parameter	Update interval	Limit
0 h to 2 h – Minimum	05:00	≥ 05:00
0 h to 2 h – Maximum	15:09	≤ 30:00*
2 h to 6 h – Minimum	29:52	≥ 05:00
2 h to 6 h – Maximum	30:08	≤ 30:00*
6 h to 24 h – Minimum	59:13	≥ 05:00
6 h to 24 h – Maximum	60:47	≤ 60:00*
Assessment	Result	
Results indicate that data changes as per C/S T.001 4.5.5.4 (Y/N)	Y	
Results indicate that data changes as per manufacturer's update scheme (Y/N)	Y	

① Input from GPS simulator

* In accordance with clause 4.5.5.4 of C/S T.001, these are the maximum limits between attempts by the navigation device to obtain a location update. The manufacturer has declared that the navigation device is powered up for a maximum time of 3 minutes and 35 seconds at each attempt. Therefore, the maximum time between encoded position updates is 33 minutes and 35 seconds during the first 6 hours of operation, and 63 minutes and 35 seconds between 6 hours after activation and the end of the declared operating lifetime.

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

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

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

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

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

Location: N 51° 22.583' W 1° 49.833' ①		
Data Acquired at	15:03:33	FFFE2F8C9EF9C06333A03ECA66771DA4D4D0
GPS Signal Navigation Data Removed		
Last Message with Encoded Data	19:07:19	FFFE2F8C9EF9C06333A03ECA66771DA4D4D0
Data Updated at	19:08:08	FFFE2F8C9EF9C0637FDFF83D15B783E0F66C
Last Valid Position Held	243 min 46 s	
Return to Default Position	✓	

① Input from GPS simulator

Summary

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

2.14 TESTING OPERATOR CONTROLS

2.14.1 Specification

Cospas-Sarsat T.007, Clause A.3.10

2.14.2 Equipment Under Test and Modification State

ResQlink (PLB 425) S/N: 3 RTCM - Modification State 2

2.14.3 Date of Test

01 November 2018

2.14.4 Test Equipment Used

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

2.14.5 Environmental Conditions

Ambient Temperature 22.0°C
Relative Humidity 31.9%

2.14.6 Test Results

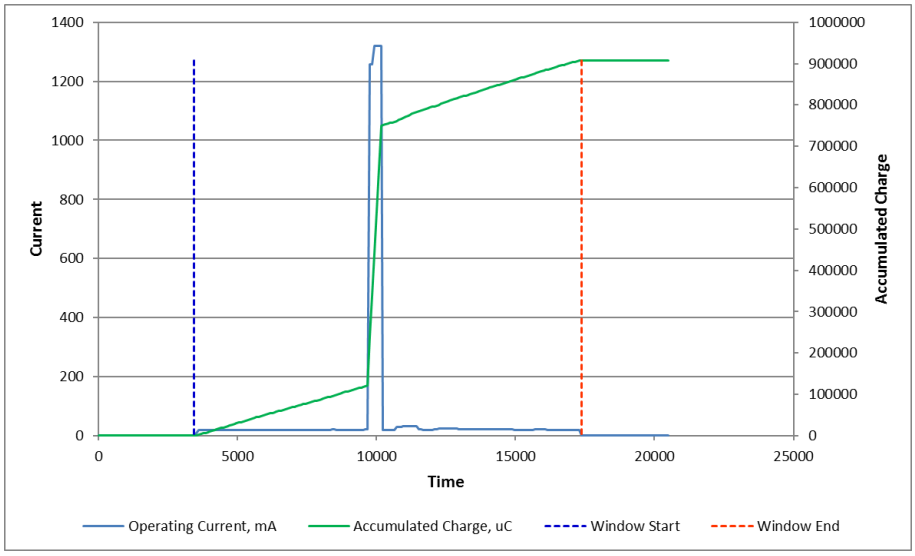
Testing Self-Test Controls

The EUT has a common Self-Test and GNSS Self-Test control. In accordance with the manufacturer design, the 'TEST' button should be held for >2 <5 seconds then released to initiate a Self-Test procedure. Holding the 'TEST' button for >5 <10 seconds will initiate a GNSS Self-Test procedure.

In accordance with C/S T.007, section A.3.10, the EUT was tested as follows (the results are presented using battery current plots):

Test 1

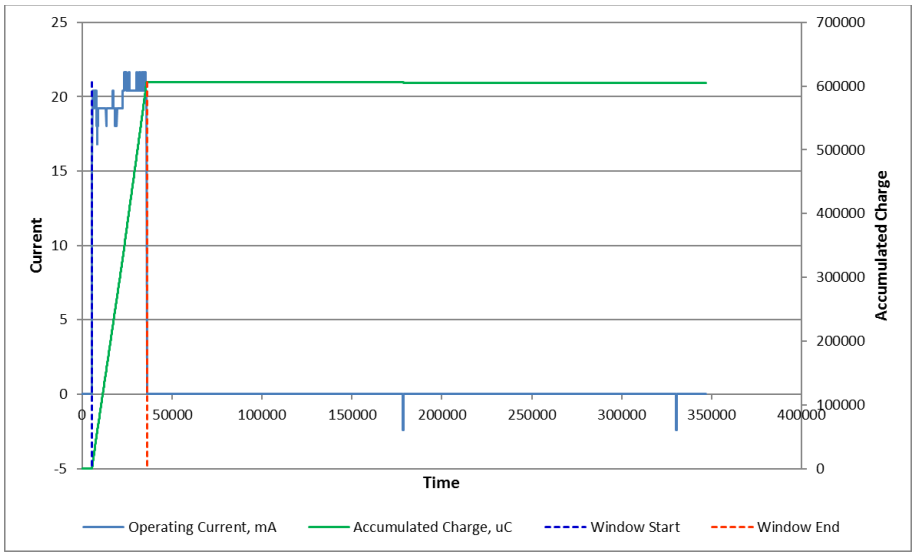
The Self-Test button was held for X-1 seconds (where X is the time required to activate a GNSS Self-Test). In this case, time to activate a GNSS Self-Test is 5 seconds – therefore the 'TEST' button was released after 4 seconds:



The EUT transmitted a single 406 burst, and self-terminated after 13.9 seconds.

Test 2

The Self-Test button was held continuously for 5 minutes longer than the maximum duration of the test.



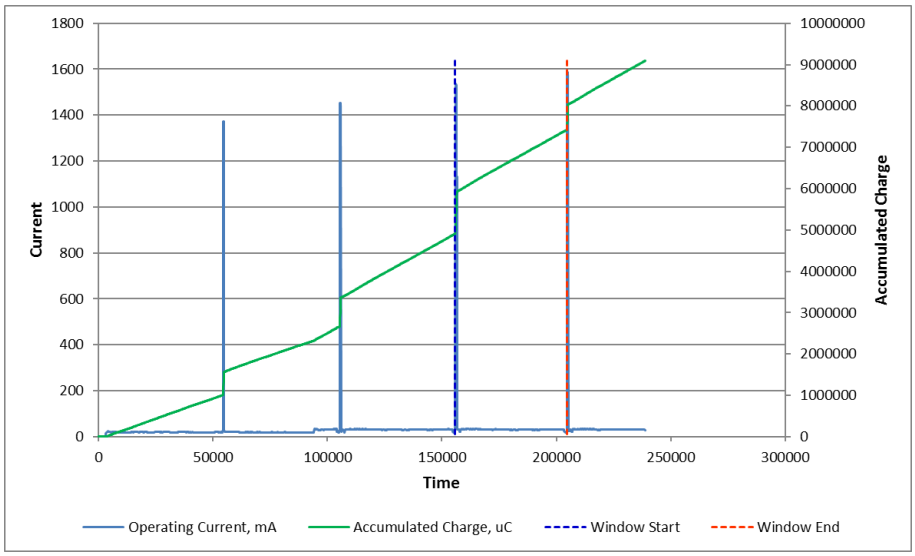
The EUT did not perform any 406 transmissions and self-terminated after 30.5 seconds. The EUT did not draw any further current with the 'TEST' button held for a further 5 minutes.

NOTE: If the Self-Test button is continuously held, the EUT will power down approximately 30 seconds after activation.

Testing Operational Controls

Test 1

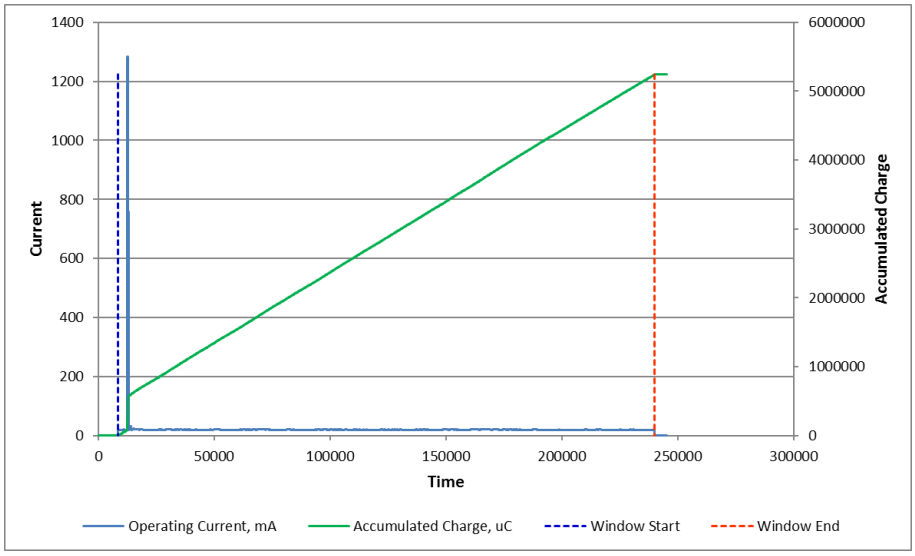
The EUT 'ON' button was continuously held for 3 minutes longer than the declared time to transmit the first 406MHz distress message:



The EUT continued to transmit 406MHz distress messages within the repetition rate limits stated in C/S T.007. The maximum and minimum repetition rate times observed were 51.0 seconds and 48.9 seconds respectively.

Test 2

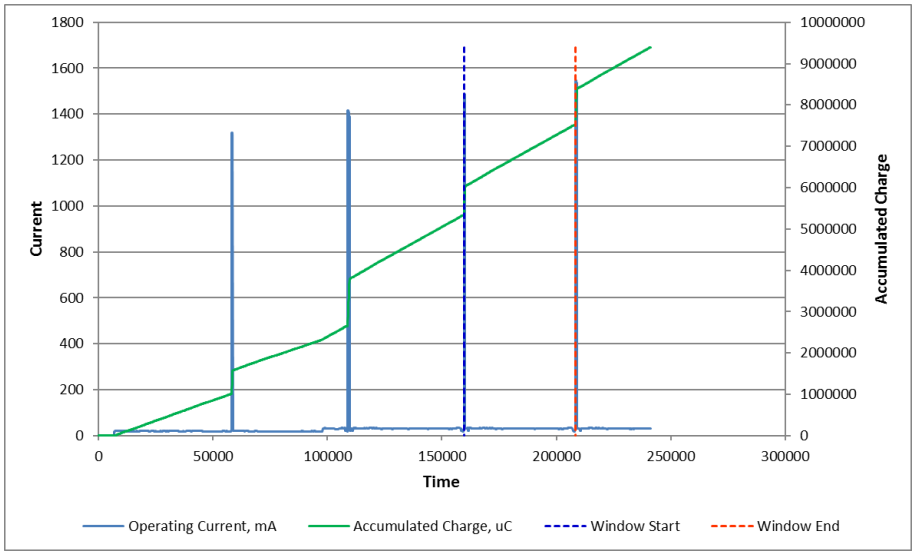
The EUT ‘TEST’ button was held, and after two seconds, the EUT ‘ON’ button was simultaneously held. Both buttons were held for 3 minutes longer than the manufacturer declared time to transmit the first 406 MHz distress message:



After 4.6 seconds the EUT transmitted a 406 MHz Self-Test message. The EUT continued to draw a residual current of approximately 20mA until the TEST and ON buttons were released.

Test 3

The EUT ‘ON’ button was held, and after five seconds, the EUT ‘TEST’ button was simultaneously held. Both buttons were held for 3 minutes longer than the manufacturer declared time to transmit the first 406 MHz distress message:



The EUT activated in distress mode continued to transmit 406MHz distress messages within the repetition rate limits stated in C/S T.007. The maximum and minimum repetition rate times observed were 50.8 seconds and 48.8 seconds respectively.

2.14.7 Conclusions

The EUT does not transmit more than one 406MHz burst in Self-Test or GNSS Self-Test mode as required by C/S T.001.

The EUT does not transmit more frequently than the repetition rate defined by C/S T.001.

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 2.12 Beacons - Antenna Characteristics					
Antenna, (Tuned Dipole Set)	Roberts Antenna	A-100	569	-	TU
Spectrum Analyser	Agilent Technologies	E7405A	1410	12	23-Aug-2018
Roberts Antenna 406MHz	Compliance Design		1860	24	06-Apr-2020
Hygromer	Rotronic	A1	2138	12	21-Feb-2019
Beacon Tester	WS Technologies	BT100S	3263	-	TU
Section 2.9 / 2.14 Beacons - Battery Current Measurements / Testing Operator Controls					
Hygromer	Rotronic	I-1000	2829	12	04-Dec-2019
8 Channel Datalogger + Terminal Board	Pico Technology Ltd	ADC-16	3287	12	08-Jan-2020
Variable Resistive Load	TUV SUD Product Service	n/a	5057	12	12-Dec-2019

Section 2.1, 2.2, 2.3, 2.4, 2.6, 2.7 Beacons - Constant Temperature Tests					
Climatic Chamber	Heraeus Votsch	VMT 04/30	40	-	O/P Mon
Thermometer	R.S Components	615-8206	3612	12	25-Sep-2019
GPS/SBAS Simulator	Spirent	STR4500	3056	12	06-Oct-2019
Power Meter	Hewlett Packard	436A	83	12	26-Sep-2019
Climatic Chamber	Heraeus Votsch	VM 04/100	85	-	O/P Mon
Beacon RF Unit	TUV SUD Product Service	N/A	97	-	TU
Signal Generator	Hewlett Packard	8644A	199	12	27-Apr-2019
Attenuator 10dB 10W	Weinschel	47-10-34	398	12	18-Jul-2019
Attenuator (10dB, 75W)	Bird	8308-100	469	12	19-Dec-2018
Attenuator (10dB, 10W)	Weinschel	23-10-34	470	12	18-Dec-2018
3dB/10W Attenuator	Texscan	HFP-50N	475	12	13-Apr-2019
Attenuator: 10dB/20W	Narda	766-10	480	12	18-Dec-2018
Signal Generator (100kHz to 2.6GHz)	Hewlett Packard	8663A	1063	12	23-Apr-2019
Spectrum Analyser	Agilent Technologies	E7405A	1410	12	13-Sep-2019
Distress Beacon RF Unit	TUV SUD Product Service	-	2445	-	TU
Stop Clock	R.S Components	RS328 061	2674	12	25-Jul-2019
Spectrum Analyser	Rohde & Schwarz	FSU26	2747	12	19-Feb-2019
Hygromer	Rotronic	I-1000	2829	12	29-Nov-2018
Attenuator (3dB, 20W)	Aeroflex / Weinschel	23-03-34	3162	12	20-Dec-2018
Bandpass Filter	Trilithic	5BE406/35-1-AA	3205	12	08-Jan-2019
Time Interval Analyser	Yokogawa	TA720 704510	3253	12	16-Nov-2018
ScopeCorder	Yokogawa	DL750 701210	3254	12	10-Nov-2018
Power Sensor	Agilent Technologies	8482A	3290	12	19-Apr-2019
Rubidium Frequency Standard	Symmetricom	8040C	3490	12	11-May-2019
Signal Analyser	Rohde & Schwarz	FSQ 26	3545	12	14-Mar-2019
Meter & T/C	R.S Components	Meter 615-8206 & Type K T/C	3612	12	25-Sep-2019
ScopeCorder	Yokogawa	DL750	4175	12	29-Jan-2019
1 metre N-Type Cable	Florida Labs	NMS-235SP-39.4-NMS	4510	12	10-Jul-2019
1 metre N-Type Cable	Florida Labs	NMS-235SP-39.4-NMS	4511	12	24-Apr-2019
Time Interval Analyser	Yokogawa	TA720	4550	12	14-Mar-2019
Bandpass Filter (1MHz)	KR Electronics	3219-SMA	4600	12	03-Sep-2019
Bandpass Filter (1MHz)	KR Electronics	3219-SMA	4602	12	03-Sep-2019
Cable (18GHz)	Rosenberger	LU7-036-1000	5025	-	O/P Mon
Cable (18GHz)	Rosenberger	LU7-036-1000	5028	-	O/P Mon
Cable (18GHz)	Rosenberger	LU7-036-1000	5029	-	O/P Mon
Section 2.5 Beacons - Spurious Emissions					
Climatic Chamber	Heraeus Votsch	VM 04/100	85	-	O/P Mon
Attenuator 10dB 10W	Weinschel	47-10-34	398	12	18-Jul-2019
Attenuator (10dB, 75W)	Bird	8308-100	469	12	19-Dec-2018
Spectrum Analyser	Rohde & Schwarz	FSU26	2747	12	19-Feb-2019
Rubidium Frequency Standard	Symmetricom	8040C	3490	12	11-May-2019
Meter & T/C	R.S Components	Meter 615-8206 & Type K T/C	3612	12	25-Sep-2019
Cable (18GHz)	Rosenberger	LU7-036-1000	5025	-	O/P Mon
Cable (18GHz)	Rosenberger	LU7-036-1000	5028	-	O/P Mon

Section 2.13 Beacons - Navigation System					
Antenna (Double Ridge Guide,1GHz-18GHz)	EMCO	3115	35	12	08-Dec-2018
Directional Coupler	Narda	3022	503	-	O/P Mon
Spectrum Analyser	Agilent Technologies	E4407B	1154	12	09-Oct-2019
Screened Room (2)	Rainford	Rainford	1542	-	TU
GPS/SBAS Simulator	Spirent	STR4500	3056	12	06-Oct-2019
Copper GRP	TUV SUD Product Service	27cm Diameter	3538	-	TU
Non Conductive Standoff Box	TUV SUD Product Service	Non Conductive Standoff Box	4966	-	TU
Cable (18GHz)	Rosenberger	LU7-036-1000	5029	-	O/P Mon
Cable (18GHz)	Rosenberger	LU7-036-2000	5035	-	O/P Mon
Section 2.9 Beacons - Operating Lifetime					
Power Meter	Hewlett Packard	436A	83	12	26-Sep-2019
Thermometer	R.S Components	615-8206	3612	12	25-Sep-2019
Climatic Chamber	Heraeus Votsch	VM 04/100	85	-	O/P Mon
Signal Generator	Hewlett Packard	8644A	199	12	27-Apr-2019
Attenuator 10dB 10W	Weinschel	47-10-34	398	12	18-Jul-2019
Attenuator (10dB, 75W)	Bird	8308-100	469	12	19-Dec-2018
3dB/10W Attenuator	Texscan	HFP-50N	475	12	13-Apr-2019
Spectrum Analyser	Agilent Technologies	E7405A	1410	12	13-Sep-2019
Distress Beacon RF Unit	TUV SUD Product Service	-	2445	-	TU
Hygromer	Rotronic	I-1000	2829	12	29-Nov-2018
Power Sensor	Agilent Technologies	8482A	3290	12	19-Apr-2019
Rubidium Frequency Standard	Symmetricom	8040C	3490	12	11-May-2019
ScopeCorder	Yokogawa	DL750	4175	12	29-Jan-2019
1 metre N-Type Cable	Florida Labs	NMS-235SP-39.4-NMS	4511	12	24-Apr-2019
Time Interval Analyser	Yokogawa	TA720	4550	12	14-Mar-2019
Bandpass Filter (1MHz)	KR Electronics	3219-SMA	4602	12	3-Sep-2019
2 metre N-Type Cable	Florida Labs	NMS-235SP-78.8-NMS	4622	12	10-Jul-2019
30dB Attenuator	Narda	766-30	4783	12	19-Dec-2018
Cable (18GHz	Rosenberger	LU7-036-1000	5026	-	O/P Mon
Section 2.11 Beacons - Satellite Qualitative Test					
Beacon Tester	WS Technologies	BT100S	3263	-	TU
Hygropalm Temperature and Humidity Meter	Rotronic	HP21	4410	12	24-May-2019
Copper GRP	TUV SUD Product Service	27cm Diameter	3538	-	TU
Non Conductive Standoff Box	TUV SUD Product Service	Non Conductive Standoff Box	4966	-	TU

Section 2.10 Beacons - Temperature Gradient					
Power Meter	Hewlett Packard	436A	83	12	26-Sep-2019
Thermometer	R.S Components	615-8206	3612	12	25-Sep-2019
Climatic Chamber	Heraeus Votsch	VM 04/100	85	-	O/P Mon
Signal Generator	Hewlett Packard	8644A	199	12	27-Apr-2019
Attenuator 10dB 10W	Weinschel	47-10-34	398	12	18-Jul-2019
Attenuator (10dB, 75W)	Bird	8308-100	469	12	19-Dec-2018
3dB/10W Attenuator	Texscan	HFP-50N	475	12	13-Apr-2019
Distress Beacon RF Unit	TUV SUD Product Service	-	2445	-	TU
Hygromer	Rotronic	I-1000	2829	12	29-Nov-2018
Bandpass Filter	Trilithic	5BE406/35-1-AA	3207	12	18-Jul-2019
Power Sensor	Agilent Technologies	8482A	3290	12	19-Apr-2019
Rubidium Frequency Standard	Symmetricom	8040C	3490	12	11-May-2019
ScopeCorder	Yokogawa	DL750	4175	12	29-Jan-2019
Time Interval Analyser	Yokogawa	TA720	4550	12	14-Mar-2019
Bandpass Filter (1MHz)	KR Electronics	3219-SMA	4602	12	03-Sep-2019
Cable (18GHz)	Rosenberger	LU7-036-1000	5026	-	O/P Mon
Cable (18GHz)	Rosenberger	LU7-036-1000	5028	-	O/P Mon
Section 2.8 Beacons - Thermal Shock					
Climatic Chamber	Heraeus Votsch	VMT 04/30	40	-	O/P Mon
Thermometer	R.S Components	615-8206	3612	12	25-Sep-2019
Power Meter	Hewlett Packard	436A	83	12	26-Sep-2019
Climatic Chamber	Heraeus Votsch	VM 04/100	85	-	O/P Mon
Signal Generator	Hewlett Packard	8644A	199	12	27-Apr-2019
Attenuator 10dB 10W	Weinschel	47-10-34	398	12	18-Jul-2019
Attenuator (10dB, 75W)	Bird	8308-100	469	12	19-Dec-2018
3dB/10W Attenuator	Texscan	HFP-50N	475	12	13-Apr-2019
Distress Beacon RF Unit	TUV SUD Product Service	-	2445	-	TU
Hygromer	Rotronic	I-1000	2829	12	29-Nov-2018
Bandpass Filter	Trilithic	5BE406/35-1-AA	3207	12	18-Jul-2019
Power Sensor	Agilent Technologies	8482A	3290	12	19-Apr-2019
Rubidium Frequency Standard	Symmetricom	8040C	3490	12	11-May-2019
ScopeCorder	Yokogawa	DL750	4175	12	29-Jan-2019
Time Interval Analyser	Yokogawa	TA720	4550	12	14-Mar-2019
Bandpass Filter (1MHz)	KR Electronics	3219-SMA	4602	12	03-Sep-2019
Cable (18GHz)	Rosenberger	LU7-036-1000	5026	-	O/P Mon
Cable (18GHz)	Rosenberger	LU7-036-1000	5028	-	O/P Mon

Note: some tests took place over one or more days and consequently it may appear that some of the test equipment could have been outside of the valid calibration period at the time of testing. However, we confirm that all equipment held a valid and in-date calibration when used, and we hold this information on record.

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

SECTION 4

PHOTOGRAPHS

4.1 PHOTOGRAPHS OF EQUIPMENT UNDER TEST (EUT)

Front View


SARSAT Beacon Registration
NOAA, NSOF, E/SPO53
1315 East West Hwy
Silver Spring, MD
20910-3282
www.beaconregistration.noaa.gov
Buoyant - Category 1
www.ACRARTEX.com
WARNING
USE ONLY IN SITUATIONS OF GRAVE AND IMMINENT DANGER
CE 0791
CENTIMETRES

Rear View

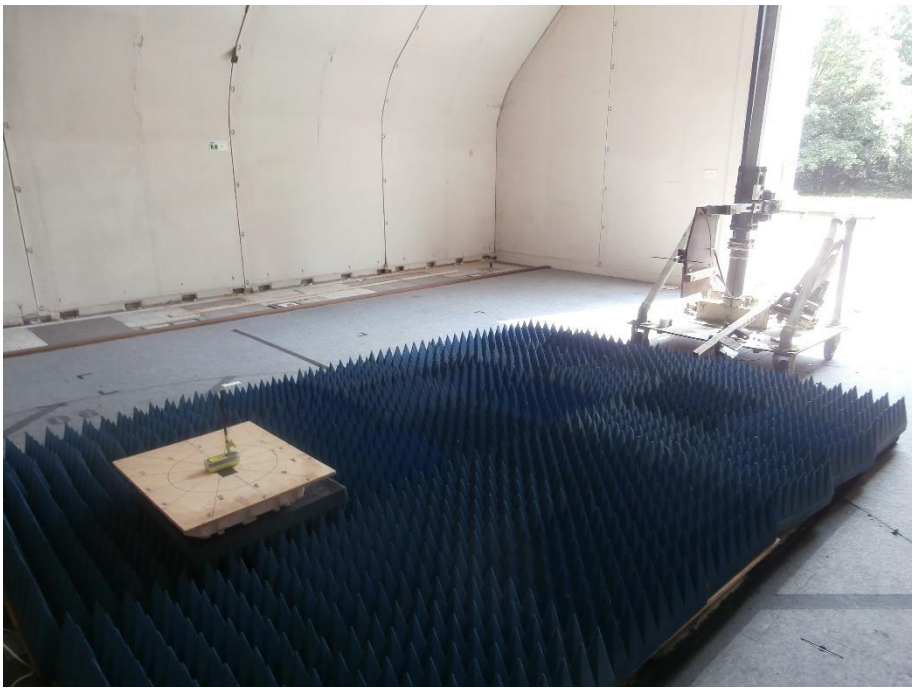
Antenna Deployed

Modified Conducted Output

Configuration 7 - Satellite Qualitative/A.3.8.2

Configuration 8 - Satellite Qualitative/A.3.8.2

Configuration 3 (B.2) - Antenna Characteristics



Configuration 4 (B.5) - Antenna Characteristics

SECTION 5

ACCREDITATION, DISCLAIMERS AND COPYRIGHT

5.1 ACCREDITATION, DISCLAIMERS AND COPYRIGHT

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

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

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

ANNEX A

Manufacturer Supplied Information

Description of Artex PLB-400 and PLB-425 Modes of Operation 10-8-2018

Per C/S T.007 5(d)

Off/Standby Mode:

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

Self-Test Mode:

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

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

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

During self-test the following occurs:

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

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

GNSS Self-Test Mode:

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

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

The maximum number of GNSS self-tests is 20.The beacon keeps a count of how many GNSS self-tests have been run. If the count exceeds 20, the beacon does not allow additional GNSS self-tests to run. If additional GNSS self-tests are attempted, the beacon reverts to Off/Standby mode. The PLB-425 will also display low bat to show that this feature has been disabled.

The beacon also checks the total ON time at the beginning of a GNSS self-test. If the total ON time exceeds 2 hr the GNSS Test cannot be performed. The PLB-425 will display the GPS coordinates when a fix is acquired.

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

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

Programming Mode:

The programming mode can be entered by pressing the Self-Test button for min 15 seconds and max 20 seconds. The beacon can be programmed at the factory for specific country and protocol. This is not an end user function. If by chance the end user enters the Programming Mode, after 41 seconds from programming mode start, a message (in PLB-425) will show "Programming Failed" and the RED led will flash (PLB-400 and PLB-425). No changes to any factory programmed data, country and/or protocol will occur. PLB-400 and PLB-425 are limited to 10 attempts to enter programming mode. Any additional attempts are ignored with no warnings displayed on the screen or LEDs.

Main Operating Mode:

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

The LED flashes red approximately every 5 seconds after the On/Off button has been pressed for 1 second. The Strobe flashes twice to indicate Activation. The LED then flashes red or green approximately every 5 seconds until the beacon is turned off or battery reaches end-of-life. Red LED flashes indicate that the unit has not received a valid fix or that 4 hours have passed without a valid GPS location update after GNSS acquisition; green LED flashes indicate that a valid GPS location has been acquired.

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

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

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

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

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

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

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

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

GPS On/Off Cycle:

The internal navigation device makes an attempt every 15 minutes to obtain an initial location; until an initial location is obtained or 2 hours has passed after beacon activation. 1st Initial attempt is on for 11 minutes.

After an initial location is obtained or 2 hours has passed after beacon activation without obtaining an initial location, the navigation device attempts location updates according to the following regime:

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

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

Statements and Descriptions for

ACR PLB-400 AND PLB-425

COSPAS-SARSAT Application

Protection against Continuous Transmission for PLB-400 AND PLB-425 (Per C/S T.007 5. j. i.)

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

Hardware:
PLB-400 AND PLB-425 is designed to limit any inadvertent 406MHz transmission:

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

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

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

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

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

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

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

Initiation of a self-test will:

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

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

3. Complete the self-test sequence.

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

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

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

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

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

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

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

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

GNSS Self-Test Mode

The GNSS self-test tests the internal GPS module. A GNSS self-test is initiated by pressing the Test button for greater than 5 seconds and less than 10 seconds. This will start the long GNSS self-test procedure if the number of allowed GNSS self-tests run has not been attained.

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

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

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

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

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

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

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

Product Service

10/16/2018

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

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

Document Number: **Y1-13-0389**

Revision: C

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

REPORT ON Emergency Beacons Testing of the
ACR Electronics, Inc.
PLB-400 and PLB-425
Document Y1-13-0389 Revision C
10/16/2018

PREPARED AND APPROVED BY

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

DATED 10/16/2018

Table of Contents

SECTION 1

REPORT SUMMARY

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

1.1 INTRODUCTION

The information contained in this report is intended to show verification of the Emergency Beacon Testing of the ACR Electronics, Inc. PLB-400 and PLB-425 to the requirements of T.007 Issue 5 – Rev 2 June 2018, Beacon Coding Software (§ A.2.8) and Position Data Encoding (§ A.3.8.7)

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

Specification	Cospas-Sarsat T.007 Issue 5 - Rev 2 June 2018
Manufacturer	ACR Electronics, Inc.
Beacon Model Number(s)	PLB-400 and PLB-425
PLB-400 and PLB-425 Assembly Model Part Number and Version	PLB-400: A3-06-3138 -1, Rev T2 PLB-425: A3-06-3138, Rev T2
PLB-400 and PLB-425 Printed circuit board P/N and version	A3-07-0469 Rev C
PLB-400 and PLB-425 Firmware Part Number and Version	K3-01-0145 Rev C
Beacon Serial Number(s)	1,2
EUT Modification State	0
Number of Samples Tested	Two
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	10/13/2018
Finish of Test	10/15/2018
Performed by	Chris Westervelt
Verified by	Bill Cox

1.2 BEACON MANUFACTURER AND BEACON MODEL

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

1.2.1 Information Provided by the Manufacturer

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

1.2.2 Applicable C/S Standards:

Document	Issue	Revision
C/S T.001	4	3
C/S T.007	5	2

1.3 REFERENCES

1.3.1 Documents

[1] Introduction to the COSPAS-SARSAT System, C/S G.003 (Issue 3 – Feb 2018)

[2] Specification for COSPAS-SARSAT 406 MHz Distress Beacons, C/S T.001 (Issue 4, Revision 3, June 2018)

[3] COSPAS-SARSAT 406 MHz Distress Beacon Type Approval Standard, C/S T.007 (Issue 5 - Revision 2, June 2018)

1.4 PRODUCT INFORMATION

1.4.1 Technical Description

The Equipment Under Test (EUT) was an ACR Electronics, Inc. PLB-400 and PLB-425 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 application software and the ACR Wand will be used for beacon communications including beacon serialization.

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

1.5 MODIFICATIONS

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

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

1.6 REPORT MODIFICATION RECORD

Revision C- First Issue on 10/16/2018.

SECTION 2

TEST DETAILS

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

TEST RESULTS TABLE

Parameters to be Measured	Range of Specification	Units	Test Results:	Comments
16. Beacon Coding Software				
Model: PLB-400, S/N: 1				
Sample message for each coding option of the applicable coding types	Correct	P / F	P	Test data in Section 2.1
Sample of self-test message for each coding option of the applicable coding types	Correct	P / F	P	Test data in Section 2.1
17. Navigation System				
Model PLB-425, S/Ns: 2				
Position Data Encoding	Correct	P / F	P	Test data in Section 2.2

2.1 BEACON CODING SOFTWARE

2.1.1 Equipment Under Test

PLB-400, Serial Number: 1

2.1.2 Date of Test and Modification State

Modification State 0 (PLB-400)

EUT system configuration during the test, including antenna, external ancillary devices, and modes of their operation.	The PLB-400 was configured as a conductive unit with 406 output going to an ACR FPR-300 to receive and decode the data.
Navigation device details	Input data from computer PC using NAVScript 1.23 and PC USB to 3.3v serial converter.

Test Start: Oct 13, 2018 11:20
Test End: Oct 15, 2018 17:30

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

2.1.3 TEST RESULTS

APPENDIX D TO ANNEX F

BEACON CODING SOFTWARE RESULTS

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

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

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

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

2 RLS protocols will be effective as of 1 November 2013. 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.

2.2 NAVIGATION SYSTEM

2.2.1 Equipment Under Test

PLB-425, Serial Number: 2

2.2.2 Date of Test and Modification State

Modification State 0 (PLB-425)

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

Test Start: Oct 13, 2018 11:20
Test End: Oct 15, 2018 17:30

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

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

Script Reference (Table D.2 C/S T.007 - Issue 5 - Revision 2 June 2018)	Value of Encoded Location Bits Transmitted by Beacon	Confirmation that BCH is Correct ( )
1	Bits 65 - 85 = 0FFBFF Bits 113 - 132 = 83E0F	PASS
2	Bits 65 - 85 = 100400 Bits 113 - 132 = 8420E Number of seconds after providing navigation data that beacon transmitted the above encoded location information: 49.00 seconds	PASS
3	Bits 65 - 85 = 000000 Bits 113 - 132 = 8360D	PASS
4	Bits 65 - 85 = 000ACF Bits 113 - 132 = 0F222	PASS
5	Bits 65 - 85 = 0012CE Bits 113 - 132 = 93A60	PASS
6	Bits 65 - 85 = 100ECF Bits 113 - 132 = 0FA10	PASS
7	Bits 65 - 85 = 1B2964 Bits 113 - 132 = 80A00	PASS
8	Bits 65 - 85 = 1B2D64 Bits 113 - 132 = 84E00	PASS
9	Bits 65 - 85 = 0B46D0 Bits 113 - 132 = 03801	PASS
10	Bits 65 - 85 = 0B42D0 Bits 113 - 132 = 08009	PASS
11	Bits 65 - 85 = 14962A Bits 113 - 132 = 80200	PASS
Self-Test Navigation Test Scripts		
12	Bits 65 - 85 = 0FFBFF Bits 113 - 132 = Bits are truncated.	PASS
13	Bits 65 - 85 = 0FFBFF Bits 113 - 132 = Bits are truncated.	PASS

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

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

Script Reference (Table D.2 C/S T.007 - Issue 5 - Revision 2 June 2018)	Value of Encoded Location Bits Transmitted by Beacon	Confirmation that BCH is Correct ( )
1	Bits 59 - 85 = 3F81FE0 Bits 113 - 126 = 27CF	PASS
2	Bits 59 - 85 = 4002000 Bits 113 - 126 = 284E Number of seconds after providing navigation data that beacon transmitted the above encoded location information: 48.00 seconds	PASS
3	Bits 59 - 85 = 0000000 Bits 113 - 126 = 26CD	PASS
4	Bits 59 - 85 = 0019678 Bits 113 - 126 = 060D	PASS
5	Bits 59 - 85 = 001567A Bits 113 - 126 = 2710	PASS
6	Bits 59 - 85 = 401B677 Bits 113 - 126 = 0740	PASS
7	Bits 59 - 85 = 6CA0B20 Bits 113 - 126 = 06C0	PASS
8	Bits 59 - 85 = 6CA2B20 Bits 113 - 126 = 21C0	PASS
9	Bits 59 - 85 = 2D03680 Bits 113 - 126 = 0701	PASS
10	Bits 59 - 85 = 2CF5680 Bits 113 - 126 = 2009	PASS
11	Bits 59 - 85 = 523F14F Bits 113 - 126 = 2040	PASS
Self-Test Navigation Test Scripts		
12	Bits 59 - 85 = 3F81FE0 Bits 113 - 126 = Bits are truncated.	PASS
13	Bits 59 - 85 = 3F81FE0 Bits 113 - 126 = Bits are truncated.	PASS

2.3 TEST EQUIPMENT USED

	Description	ACR P/N
Hardware	PC-compatible	Purchased Commercial Hardware
Operating System	Windows XP SP3 / Windows 7	
Flash Device	STM32 ST-LINK Utility and ST-LINK / V2	Purchased Commercial Hardware
Software Verification and Validation Environment and Equipment	• PC	Purchased Commercial Hardware
	• Windows Windows 7	N/A
	• IAR	K1-02-0027
	• TeraTerm V4.7or better	K1-02-0047
	• USB Cable	A3-06-2599
	• FPR-300 ACR Electronics Field Programmer/Reader or other (406 message decoder)	A3-06-2619
	• FPR 2.0.8 and ACR Wand	K3-07-0033
	• Power Supply	Purchased Commercial Hardware
	• TeraTerm Navigation Scripts	
	• Java Automation Scripts	

ANNEX B

Modification States

Results Comparison

Note

The test results presented in this annex are those performed with the EUT in Modifications States 0 and 1 and can be used as a comparison to those made in the final Modification State 2 (presented the Summary Table in section 2 of this report). A summary of all tests performed, and corresponding Modification States is shown below:

TP table ref	Title	Test Performed		
		MS0	MS1	MS2
1	Power output - ambient	YES	YES	YES
2	Digital message - ambient		YES	YES
3a	Digital Message Generator - ambient	YES	YES	YES
3b	Digital Message Generator (ELT) - ambient	Not applicable		
4	Modulation - ambient	YES	YES	YES
5	406MHz Transmitted Frequency - ambient	YES	YES	YES
6	Spurious emissions - ambient	YES	YES	YES
7	406 MHz VSWR check - ambient	YES	NO	NO
8a	Self-test mode - ambient	YES	NO	NO
	PIE - ambient	NO	YES	YES
8b	GNSS self-test mode - ambient	NO	YES	NO
1	Power output - high temp	YES	NO	YES
2	Digital message - high temp	YES	NO	YES
3a	Digital Message Generator - high temp	YES	NO	YES
3b	Digital Message Generator (ELT) - high temp	Not applicable		
4	Modulation - high temp	YES	NO	YES
5	406MHz Transmitted Frequency - high temp	YES	NO	YES
6	Spurious emissions - high temp	YES	NO	YES
7	406 MHz VSWR check - high temp	YES	NO	NO
8a	Self-test mode - high temp	YES	NO	NO
	PIE - high temp	Not applicable		
8b	GNSS self-test mode - high temp	NO	YES	NO
1	Power output - low temp	YES	NO	NO
2	Digital message - low temp	YES	NO	NO
3a	Digital Message Generator - low temp	YES	NO	NO
3b	Digital Message Generator (ELT) - low temp	Not applicable		
4	Modulation - low temp	YES	NO	NO
5	406MHz Transmitted Frequency - low temp	YES	NO	NO
6	Spurious emissions - low temp	YES	NO	NO
7	406 MHz VSWR check - low temp	YES	NO	NO
8a	Self-test mode - low temp	YES	NO	NO
	PIE - low temp	Not applicable		
8b	GNSS self-test mode - low temp	NO	YES	NO
9	Thermal shock	YES	NO	NO
10	Operating lifetime at minimum temperature	YES	NO	NO
	Battery current measurements	YES	YES	YES

11	Temperature gradient (TCXO)	YES	NO	NO
12	Oscillator Aging	Not applicable		
13	Protection against continuous transmission	Not applicable		
14a	Satellite Qualitative tests (Daedalus: on ground and above ground)	NO	C7, C8	C8
14b	Satellite Qualitative tests (ELT-DT)	Not applicable		
15	Antenna characteristics:	YES	NO	NO
16	Beacon coding software - Manufacturer's data	Manufacturer's data		
17	Navigation system - NLP	A382	A382, A386	A381, A382, A383, A384, A386
17	Navigation system - SLP	A382	A381, A383, A386	A383, A384
18	Return Link Service	Not applicable		
19	Prevention of Continious Transmission (beacon with PTT)	Not applicable		
20	Activation and Cancellation message Test (ELT-DT only) (A.3.9)	Not applicable		
A.2.10	ELT-DT with external power source (and switching between sources)	Not applicable		
A.3.10	Testing of Operator Controls	NO	NO	YES

Modification State 0 Summary

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: PLB-425, S/N: 3 RTCM, TUV Ref: TSR4 and Modification State 0							
Transmitter power output	(maximum)	35 - 39	dBm	37.14	36.63	36.33	
	(minimum)			37.00	36.43	36.07	
Power output rise time	(maximum)	< 5	ms	0.26	0.44	0.45	
	(minimum)			0.20	0.39	0.39	
Power output 1ms before burst	(maximum)	< -10	dBm	-15.44	-16.36	-14.35	
	(minimum)			-15.52	-16.43	-14.50	
2. Digital Message Coding							**Result: Pass**
Model: PLB-425, S/N: 3 RTCM, TUV Ref: TSR4 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: PLB-425, S/N: 3 RTCM, TUV Ref: TSR4 and Modification State 0							
Repetition rate, T_R:							
Average T_R		48.5 ≤ T_{Ravg} ≤ 51.5	seconds	50.227	50.230	50.230	
Minimum T_R		47.5 ≤ T_{Rmin} ≤ 48.0	seconds	47.596	47.627	47.580	
Maximum T_R		52.0 ≤ T_{Rmax} ≤ 52.5	seconds	52.417	52.432	52.432	
Standard deviation		0.5 - 2.0	seconds	1.54	1.53	1.54	
Bit rate							
Minimum fb		≥ 396	bits/sec	399.97	399.98	399.98	
Maximum fb		≤ 404	bits/sec	400.00	400.01	400.01	
Total transmission time							
Short message	(maximum)	435.6 - 444.4	ms	N/A	N/A	N/A	
	(minimum)			N/A	N/A	N/A	
Long message	(maximum)	514.8 - 525.2	ms	520.98	520.89	520.95	
	(minimum)			520.92	520.84	520.88	
Unmodulated carrier							
Minimum T1		≥ 158.4	ms	160.96	160.90	160.93	
Maximum T1		≤ 161.6	ms	161.01	160.95	161.00	
First burst delay		≥ 47.5	seconds	51	51	51	

Parameters to be Measured		Range of Specification	Units	Test Results			Comments
				Tmin	Tamb	Tmax	
				(-20°C)	(+21°C)	(+55°C)	
4. Modulation							**Result: Pass**
Model: PLB-425, S/N: 3 RTCM, TUV Ref: TSR4 and Modification State 0							
Biphase-L		P / F	P / F	P	P	P	* Phase Deviation outside the limits stated in C/S T.007. However, the results are within the Test Facility Accuracy figure stated in C/S T.008.
Rise time	(maximum)	50 - 250	µs	175.3	179.4	178.3	
	(minimum)	50 - 250	µs	157.3	164.3	161.3	
Fall time	(maximum)	50 - 250	µs	192.7	194.7	196.7	
	(minimum)	50 - 250	µs	173.6	182.6	179.7	
Phase deviation: positive	(maximum)	+(1.0 to 1.2)	radians	1.1608	1.1954	1.2262*	
	(minimum)	+(1.0 to 1.2)	radians	1.0694	1.0616	1.0879	
Phase deviation: negative	(maximum)	-(1.0 to 1.2)	radians	-1.1477	-1.1695	-1.2073*	
	(minimum)	-(1.0 to 1.2)	radians	-1.0155	-1.0508	-1.0834	
Symmetry measurement		≤ 0.05		0.0278	0.0310	0.0282	
5. 406 MHz Transmitted Frequency							**Result: Pass**
Model: PLB-425, S/N: 3 RTCM, TUV Ref: TSR4 and Modification State 0							
Nominal Value	(maximum)	C/S T.001	MHz	406.0309551	406.0309105	406.0309282	
	(minimum)			406.0309533	406.0309104	406.0309281	
Short-term stability	(maximum)	≤ $2x10^{-9}$	/100ms	95.626E-12	91.630E-12	75.843E-12	
	(minimum)			89.319E-12	82.422E-12	66.268E-12	
Medium-term stability – Slope	(maximum)	(-1 to +1)$x10^{-9}$	/minutes	88.842E-11	15.295E-11	42.361E-12	
	(minimum)			45.026E-11	-24.228E-12	-23.873E-12	
Medium-term stability – Residual frequency variation	(maximum)	≤ $3x10^{-9}$		66.938E-11	47.798E-11	28.673E-11	
	(minimum)			44.566E-11	22.704E-11	12.720E-11	
6. Spurious Emissions into 50ohms							**Result: Pass**
Model: PLB-425, S/N: 3 RTCM, TUV Ref: TSR4 and Modification State 0							
In band (406.0 – 406.1 MHz)		C/S T.001 mask	P / F	P	P	P	

Modification State 1 Summary

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: PLB-425, S/N: 3 RTCM, TUV Ref: TSR4 and Modification State 1							
Transmitter power output	(maximum)	35 - 39	dBm	-	36.69	-	
	(minimum)			-	36.48	-	
Power output rise time	(maximum)	< 5	ms	-	0.43	-	
	(minimum)			-	0.39	-	
Power output 1ms before burst	(maximum)	< -10	dBm	-	-17.73	-	
	(minimum)			-	-17.94	-	
2. Digital Message Coding							**Result: Pass**
Model: PLB-425, S/N: 3 RTCM, TUV Ref: TSR4 and Modification State 1							
Bit Sync	1 - 15	15 bits “1”	P / F	-	P	-	
Frame sync	16 - 24	“000101111”	P / F	-	P	-	
Format flag	25	1 bit	bit value	-	1	-	
Protocol flag	26	1 bit	bit value	-	0	-	
Identification / position data	27 - 85	59 bits	P / F	-	P	-	
BCH code	86 -106	21 bits	P / F	-	P	-	
Emerg. Code/nat. use/supplem. Data	107 - 112	6 bits	bit value	-	110111	-	
Additional data / BCH (if applicable)	112 - 144	32 bits	P / F	-	P	-	
Position Error (if applicable)		< 5	km	-	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: PLB-425, S/N: 3 RTCM, TUV Ref: TSR4 and Modification State 1						
Repetition rate, T_R:						
Average T_R	48.5 ≤ T_{Ravg} ≤ 51.5	seconds	-	50.278	-	
Minimum T_R	47.5 ≤ T_{Rmin} ≤ 48.0	seconds	-	47.581	-	
Maximum T_R	52.0 ≤ T_{Rmax} ≤ 52.5	seconds	-	52.431	-	
Standard deviation	0.5 - 2.0	seconds	-	1.49	-	
Bit rate						
Minimum fb	≥ 396	bits/sec	-	399.98	-	
Maximum fb	≤ 404	bits/sec	-	400.01	-	
Total transmission time						
Short message (maximum)	435.6 - 444.4	ms	-	N/A	-	
Short message (minimum)			-	N/A	-	
Long message (maximum)	514.8 - 525.2	ms	-	520.90	-	
Long message (minimum)			-	520.83	-	
Unmodulated carrier						
Minimum T1	≥ 158.4	ms	-	160.87	-	
Maximum T1	≤ 161.6	ms	-	160.94	-	
First burst delay	≥ 47.5	seconds	-	51	-	

Parameters to be Measured		Range of Specification	Units	Test Results			Comments
				Tmin	Tamb	Tmax	
				(-20°C)	(+21°C)	(+55°C)	
4. Modulation							**Result: Pass**
Model: PLB-425, S/N: 3 RTCM, TUV Ref: TSR4 and Modification State 1							
Biphase-L		P / F	P / F	-	P	-	* Phase Deviation outside the limits stated in C/S T.007. However, the results are within the Test Facility Accuracy figure stated in C/S T.008.
Rise time	(maximum)	50 - 250	µs	-	176.3	-	
	(minimum)	50 - 250	µs	-	160.3	-	
Fall time	(maximum)	50 - 250	µs	-	195.7	-	
	(minimum)	50 - 250	µs	-	178.7	-	
Phase deviation: positive	(maximum)	+(1.0 to 1.2)	radians	-	1.2033*	-	
	(minimum)	+(1.0 to 1.2)	radians	-	1.0566	-	
Phase deviation: negative	(maximum)	-(1.0 to 1.2)	radians	-	-1.1826	-	
	(minimum)	-(1.0 to 1.2)	radians	-	-1.0333	-	
Symmetry measurement		≤ 0.05		-	0.0374	-	
5. 406 MHz Transmitted Frequency							**Result: Pass**
Model: PLB-425, S/N: 3 RTCM, TUV Ref: TSR4 and Modification State 1							
Nominal Value	(maximum)	C/S T.001	MHz	-	406.0309149	-	
	(minimum)			-	406.0309148	-	
Short-term stability	(maximum)	≤ $2x10^{-9}$	/100ms	-	86.868E-12	-	
	(minimum)			-	75.910E-12	-	
Medium-term stability – Slope	(maximum)	(-1 to +1)$x10^{-9}$	/minutes	-	72.156E-12	-	
	(minimum)			-	-14.800E-12	-	
Medium-term stability – Residual frequency variation	(maximum)	≤ $3x10^{-9}$		-	43.092E-11	-	
	(minimum)			-	33.931E-11	-	
6. Spurious Emissions into 50ohms							**Result: Pass**
Model: PLB-425, S/N: 3 RTCM, TUV Ref: TSR4 and Modification State 1							
In band (406.0 – 406.1 MHz)		C/S T.001 mask	P / F	-	P	-	

Observations

Test Results presented in this Annex show that there is marginal difference between measurements made in Modification states 0, 1 and 2.

Repeat Battery Current Measurement (performed January 2019)

Due to Cospas Sarsat requests, battery current measurements have been repeated for Modification States 0 and 2, and comparisons are presented in the table below:

Operating Mode	Modification State 0	Modification State 2	% Difference
	Average Current (mA)	Average Current (mA)	Mod State 2 to 0
1, Standby	0.00000151	0.000000751	-50.40
2, ON at EUT switch (GPS Search)	50.27	49.45	-1.63
3, ON at EUT (GPS Sleep)	38.47	37.51	-2.51
4, ON at EUT (Average)	44.03	43.48	-1.26
5, Self-test	74.51	73.34	-1.57
6, GNSS Self-test	26.02	27.50	5.69
7, Programme Mode (Test Button Held)	20.29	20.03	-1.28
8, Programme Mode (Test Button Released)	22.08	21.74	-1.52

Notes: Repeat measurements show that there is marginal difference between Modification States 0 and 2.

The measurements above were made using the same fresh battery. The manufacturer has advised that anomalies in the original measurements presented in section 2.9 of this report were possibly caused by using batteries with unknown capacity usage.

To demonstrate continued compliance with the Operating Lifetime test (section 2.9) which was performed in Modification State 0 (Performed September 2018), Table F.E-2 is presented below, using the repeated measurement data from Modification States 0 and 2 (performed January 2019):

Table F.E-2 for Modification State 0 repeat measurements (performed January 2019):

Characteristic	Designation	Units	Value	Comments
Beacon manufacturers declared maximum allowed cell shelf-life (from date of cell manufacture to date of battery pack installation in the beacon)	T_{CS} or TCS	Years	1	
Declared beacon battery replacement period (from date of installation in the beacon to expiry date marked on the beacon)	T_{BR} or TBR	Years	5	
Battery pack electrical configuration	-	-		
Cell model and cell chemistry	-	-		
Nominal cell capacity	-	Ah	1.4	
Nominal battery pack capacity	C_{BN}	Ah	1.4	
Annual battery cell capacity loss (self-discharge) due to aging, as specified by cell manufacturer at ambient temperature	L_{SDC}	%	1	
Calculated battery pack capacity loss due to self-discharge: $L_{CBN} = C_{BN} - [C_{BN} * (1 - L_{SDC}/100)^{TBR+TCS}]$	L_{CBN}	Ah	0.0819	
Number of self-tests per year	N_{ST}	-	12	
Average battery current during a self-test	I_{ST}	mA	74.51	
Maximum duration of a self-test	T_{ST}	s	14	Manufacturer Declared Value
Calculated battery pack capacity loss due to self-tests during battery replacement period: $L_{ST} = I_{ST} * T_{ST} * T_{BR} * (N_{ST} / 3600)$	L_{ST}	mAh	17.39	
Maximum Number of GNSS self-tests between battery replacements	N_{GST}	-	20	
Average battery current during a GNSS self-test of maximum duration	I_{GST}	mA	26.02	
Maximum duration of a GNSS self-test	T_{GST}	s	110	Manufacturer Declared Value
Calculated battery pack capacity loss due to GNSS self-tests during battery replacement period: $L_{GST} = I_{GST} * T_{GST} * (N_{GST} / 3600)$	L_{GST}	mAh	15.901	
Average stand-by battery pack current	I_{SB}	mA	0.00000151	
Other Capacity Losses	L_{OTH}	mAh	3.3	Programming
Battery pack capacity loss due to constant operation of circuitry prior to beacon activation: $L_{ISB} = I_{SB} * T_{BR} * 8760$	L_{ISB}	mAh	0.0661	
Calculated value of the battery pack pre-test discharge $L_{CDC} = L_{CBN} + 1.65((L_{ST} + L_{GST} + L_{ISB})/1000) + (L_{OTH}/1000)$	L_{CDC}	Ah	0.1403	

Note: If the end user inadvertently enters programming mode (by holding the TEST button for >15s <20s**), the EUT will draw current for approximately 54 seconds before powering down with no further action (see manufacturer documentation for further details).
The average current during this time was measured as 22.08mA. This equates to 0.33mAh. The manufacturer has declared that this feature can only be accessed a maximum of 10 times - any further attempts cause no action from the EUT.
Therefore, the overall maximum current drain = 0.33mAh * 10 attempts = 3.3mAh

** This is the worst case scenario - if the Test button is continuously held, the EUT will power down earlier, thereby drawing less overall current. See battery current measurement plots for details.

Table F.E-2 for Modification State 2 repeat measurements (performed January 2019):

Characteristic	Designation	Units	Value	Comments
Beacon manufacturers declared maximum allowed cell shelf-life (from date of cell manufacture to date of battery pack installation in the beacon)	T_{CS} or TCS	Years	1	
Declared beacon battery replacement period (from date of installation in the beacon to expiry date marked on the beacon)	T_{BR} or TBR	Years	5	
Battery pack electrical configuration	-	-		
Cell model and cell chemistry	-	-		
Nominal cell capacity	-	Ah	1.4	
Nominal battery pack capacity	C_{BN}	Ah	1.4	
Annual battery cell capacity loss (self-discharge) due to aging, as specified by cell manufacturer at ambient temperature	L_{SDC}	%	1	
Calculated battery pack capacity loss due to self-discharge: $L_{CBN} = C_{BN} - [C_{BN} * (1 - L_{SDC}/100)^{TBR+TCS}]$	L_{CBN}	Ah	0.0819	
Number of self-tests per year	N_{ST}	-	12	
Average battery current during a self-test	I_{ST}	mA	73.34	
Maximum duration of a self-test	T_{ST}	s	14	Manufacturer Declared Value
Calculated battery pack capacity loss due to self-tests during battery replacement period: $L_{ST} = I_{ST} * T_{ST} * T_{BR} * (N_{ST} / 3600)$	L_{ST}	mAh	17.11	
Maximum Number of GNSS self-tests between battery replacements	N_{GST}	-	20	
Average battery current during a GNSS self-test of maximum duration	I_{GST}	mA	27.5	
Maximum duration of a GNSS self-test	T_{GST}	s	110	Manufacturer Declared Value
Calculated battery pack capacity loss due to GNSS self-tests during battery replacement period: $L_{GST} = I_{GST} * T_{GST} * (N_{GST} / 3600)$	L_{GST}	mAh	16.806	
Average stand-by battery pack current	I_{SB}	mA	0.000000751	
Other Capacity Losses	L_{OTH}	mAh	3.2	Programming
Battery pack capacity loss due to constant operation of circuitry prior to beacon activation: $L_{ISB} = I_{SB} * T_{BR} * 8760$	L_{ISB}	mAh	0.0329	
Calculated value of the battery pack pre-test discharge $L_{CDC} = L_{CBN} + 1.65((L_{ST} + L_{GST} + L_{ISB})/1000) + (L_{OTH}/1000)$	L_{CDC}	Ah	0.1411	

Note: If the end user inadvertently enters programming mode (by holding the TEST button for >15s <20s**), the EUT will draw current for approximately 54 seconds before powering down with no further action (see manufacturer documentation for further details).
The average current during this time was measured as 21.74mA. This equates to 0.32mAh. The manufacturer has declared that this feature can only be accessed a maximum of 10 times - any further attempts cause no action from the EUT.
Therefore, the overall maximum current drain = 0.32mAh * 10 attempts = 3.2mAh
** This is the worst case scenario - if the Test button is continuously held, the EUT will power down earlier, thereby drawing less overall current. See battery current measurement plots for details.

Observations

The required pre-discharge value calculated for Modification State 0 (performed January 2019) shows a marginal decrease from 0.1409 Ah (see Modification State 0, section 2.9) to 0.1403 Ah – a reduction of 0.0006 Ah which is a decrease of 0.4%. Therefore, the predischarge values used in section 2.9 of this report are the worst case when comparing Modification State 0 measurements.

The required pre-discharge value calculated for Modification State 2 (performed January 2019) shows a marginal increase from 0.1409 Ah (see Modification State 0, section 2.9) to 0.1411 Ah – an additional 0.0002 Ah which is an increase of 0.1%.

Assuming a worst-case value of Operating Current (36.4mA – mode A3 for Modification State 0, section 2.9), this would equate to an additional required predischarge time of:

0.0002 / 0.0364 = 0.005 hours = (18 seconds)

Conclusions:

Modifications to the EUT during the approval made negligible difference to the operating current of the EUT.