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Report On

Emergency Beacons Testing of the
Breitling EMERGENCY
In accordance with Cospas-Sarsat T.007

Document 75924041 Report 01 Issue 7 February 2014

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REPORT ON

Emergency Beacons Testing of the
Breitling EMERGENCY

Document 75924041 Report 01 Issue 7

February 2014

PREPARED FOR

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DATED

14 February 2014

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0141

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CONTENTS

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SECTION 1

REPORT SUMMARY

Emergency Beacons Testing of the
Breitling EMERGENCY

1.1 INTRODUCTION

The information contained in this report is intended to show verification of the Emergency Beacon Testing of the Breitling EMERGENCY 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	Breitling
Model Number(s)	EMERGENCY
Serial Number(s)	M5 (Conducted Measurements) M1 (Antenna Tests and Satellite Qualitative) M6 (Battery Current Measurements)
Number of Samples Tested	3
Test Specification/Issue/Date	Cospas-Sarsat T.007 Issue 4 - Rev 7 October 2012
Incoming Release Date	Application Form 04 October 2013
Date of Receipt of Test Samples	02 September 2013
Order Number Date	QAF (Quote140856) 30 August 2013
Start of Test	3 September 2013
Finish of Test	19 September 2013
Name of Engineer(s)	M Hardy T Guy
Related Documents	Cospas-Sarsat T.001 Issue 3 - Rev 13 October 2012

1.2 APPLICATION FORM

Beacon Manufacturer and Beacon Model

Beacon Manufacturer	BREITLING SA
Beacon Model	EMERGENCY
Other Model Names	

Beacon Type and Operational Configurations

Beacon Type	**Beacon used while:**	**Tick where appropriate**
EPIRB	Floating in water or on deck or in a safety raft	☐
PLB	On ground and above ground	☐
	On ground and above ground and floating in water	☐
ELT Survival	On ground and above ground	☐
	On ground and above ground and floating in water	☐
ELT Auto Fixed	Fixed ELT with aircraft external antenna	☐
ELT Auto Portable	In aircraft with an external antenna	☐
	On ground, above ground, or in a safety raft with an integrated antenna	☐
ELT Auto Deployable	Deployable ELT with attached antenna	☐
Other (specify)	above ground	☒

Beacon Characteristics

Characteristic	**Specification**
Operating frequency	406,040 MHz and 121,500 MHz
Operating temperature range	Tmin = -20 °C Tmax = +55 °C
Operating lifetime	18 Hrs
Beacon power supply type (internal, external, combined, other)	Internal
External power supply parameters (AC/DC and nominal voltages)	N/A
Is external power supply needed to energise the beacon or its ancillary devices in any of operation modes (Y/N or Yes of No)	No
Battery cell chemistry	Li-Ion NMC / Si
Battery cell model name, size and number of cells in a battery pack, and details of the battery pack electrical configuration	1INP63438 Size 34x37x5,9mm / 1 cell Battery pack configuration : 1P1S
Battery cell manufacturer	PROLLION, GRENOBLE, FR

Characteristic	Specification
Battery pack manufacturer and part number	PROLLION, P/N: PLB-00018
Beacon manufacturers declared maximum allowed cell shelf-life (from date of cell manufacture to date of battery pack installation in the beacon)	1 year
Declared beacon battery replacement period (from date of installation in the beacon to expiry date marked on the beacon)	2 years
Oscillator type (e.g. OCXO, MCXO, TCXO)	TCXO
Oscillator manufacturer	RAKON UK Ltd in the Lincoln, UK
Oscillator part name and number	E5829LF
Oscillator satisfies long-term frequency stability requirements (Yes or No)	YES
Antenna type: Integral or Other (e.g. External, Detachable – specify type)	Integrated
Antenna manufacturer	BREITLING
Antenna part name and number	Antenne 406 - 121.5 MHz, P/N: 109.024
Navigation device type (Internal, External or None)	None
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)	N/A
Features in beacon that ensures erroneous position data is not encoded into the beacon message (Yes, No or N/A)	N/A
Navigation device capable of supporting global coverage (Yes, No or N/A)	N/A
For Internal Navigation Devices	N/A
- Geodetic reference system (WGS 84 or GTRF)	N/A
- GNSS receiver cold start forced at every beacon activation (Yes or No)	N/A
- Navigation device manufacturer	N/A
- Navigation device model name and part Number	N/A
- Internal navigation device antenna type (integrated, internal, external, passive/active), manufacturer and model	N/A
- GNSS system supported (e.g. GPS, GLONASS, Galileo)	N/A
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

Characteristic	Specification	
- 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
- Self-test has separate switch position (Yes or No)	No	N/A
- Self-test switch automatically returns to normal position when released (Yes or No)	N/A	N/A
- Self-test activation can cause an operational mode transmission (Yes or No)	No	N/A
- Self-test causes a single beacon self-test message burst only regardless of how long the self-test activation mechanism applied (Yes or No)	Yes	N/A
- Results of self-test indicated by (e.g. Pass / Fail Indicator Light, Strobe Light, etc.)	Red/green Light	N/A
- The content of the encoded position data fields of the self-test message has default values	N/A	N/A
- Self-test can be activated from beacon remote activation points (Yes or No)	No	N/A
- Self-test performs an internal check and indicates that RF power emitted at 406 MHz and 121.5 MHz if beacon includes a 121.5 MHz homer (Yes or No)	Yes	N/A
- Self-test transmits a signal(s) other than at 406 MHz (Yes & details or No)	No	N/A
- Self-test can be activated directly at beacon (Yes or No)	No	N/A
- List of Items checked by self-test		N/A
- Self-test transmission burst duration (440 or 520 ms)	440	
- Self-test format bit (“0” or “1”)	0	
- Maximum duration of Self Test	3s	N/A
- Maximum number of GNSS Self Tests (beacons with internal navigation devices only)	N/A	
- Self-test results in transmission of a single burst, irrespectively of the test result (Yes or No)	Yes	
- Maximum number of self-tests during battery pack replacement period	Min. 12 (Each two months) Max. is not determined because self test carry out each full battery charge.	N/A
- List all methods of Self-test mode and GNSS Self-test mode activation. Provide details on a separate sheet, if insufficient space to describe		

Characteristic	Specification	
Message Coding Protocols:	(x) Tick the boxes below against the intended protocol options	
User Protocol (tick where appropriate)	☐	Maritime with MMSI
	☐	Maritime with Radio Call Sign
	☐	EPIRB Float Free with Serial Number
	☐	EPIRB Non Float Free with Serial Number
	☐	Radio Call Sign
	☐	Aviation
	☐	ELT with Serial Number
	☐	ELT with Aircraft Operator and Serial Number
	☐	ELT with Aircraft 24-bit Address
	☒	PLB with Serial Number
	☐	National (Short Message Format)
	☐	National (Long Message Format)
Standard Location Protocol (tick where appropriate)	☐	EPIRB with MMSI
	☐	EPIRB with Serial Number
	☐	ELT with 24-bit Address
	☐	ELT with Aircraft Operator Designator
	☐	ELT with Serial Number
	☐	PLB with Serial Number
National Location Protocol (tick where appropriate)	☐	National Location: EPIRB
	☐	National Location: ELT
	☐	National Location: PLB
RLS Location Protocol (tick where appropriate) [1]	☐	EPIRB
	☐	ELT
	☐	PLB
User Location Protocol (tick where appropriate)	☐	Maritime with MMSI
	☐	Maritime with Radio Call Sign
	☐	EPIRB Float Free with Serial Number
	☐	EPIRB Non Float Free with Serial Number
	☐	Radio Call Sign
	☐	Aviation
	☐	ELT with Serial Number
	☐	ELT with Aircraft Operator and Serial Number
	☐	ELT with Aircraft 24-bit Address
	☐	PLB with Serial Number

[1] RLS protocols will be effective as of 1 November 2014. 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.

Characteristic	Specification
Beacon includes a homer transmitter (Yes or No)	Yes
-Homer transmitter(s) frequency	121.500 MHz
-Homer transmitter(s) Power	15 dBm
-Homer transmitter(s) Duty Cycle	33%
-Duty Cycle of Homer Swept Tone	35%
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.	Charger
Beacon includes automatic activation mechanism (Yes or No) Specify type of automatic beacon activation mechanism	Yes The 121.5MHz transmitter is cut off under 0°C to allow the best OLT for 406MHz at low temperature
Beacon includes features and functions not listed above, related or nonrelated to 406 MHz (Yes or No) List features and use a separate sheet if insufficient space	No
Beacon model hardware part number (P/N) and version	Spin5-PCB-Emergency-Watch-II
Beacon model software/firmware P/N and version, date of issues/releases	P/N :breitling_7.15 Version: 7.15 Release: 29th Aug 2013
Beacon model printed circuit board P/N and version	P/N : CIU_B001390 Version : 4A

Dated: October 4th 2013

October 4th, 2013.

BREITLING
P.O. BOX 1132
2540 GRENCHEN
SWITZERLAND

Signed: Jean-Paul GIRARDIN - Vice President
(Name, Position and Signature of Beacon Manufacturer Representative)

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: October 2012

Applicable C/S Standards:

Document	Issue	Revision	Date
C/S T.001	3	13	Oct-12
C/S T.007	4	7	Oct-12

I hereby confirm that the 406 MHz beacon described above has been successfully tested in accordance with the Cospas-Sarsat Type Approval Standard (C/S T.007) and complies with the Specification for Cospas-Sarsat 406 MHz Distress Beacons (C/S T.001) as demonstrated in the attached report, with the exception of the following tests which can be considered a pass when applying the Test House Facility Accuracy figures stated in T.008:

Modulation,
VSWR Modulation.

The following tests are recorded as Non-Compliances when tested in accordance with the Cospas-Sarsat Type Approval Standard (C/S T.007) and do not comply with the Specification for Cospas-Sarsat 406 MHz Distress Beacons (C/S T.001) as demonstrated in the attached report:

Operating Lifetime at 0°C.
Operating Lifetime at -20°C.

A deviation to the standard was made to the antenna characteristics test to provide further measurements points for the Configuration 4. These measurements were requested in Worksheet 02 of case 2013-06.

Current measurements included in section 2.7 were carried out with the EUT powered from an external power supply, rather than the EUT battery. The power supply was used to overcome the difficulty of connecting the current measurements equipment to the battery cell integrated in the EUT.

A deviation was made to the calculations of the pre-test discharge based upon values specified by the cell manufacturer Prollion. These figures include irreversible losses during storage (3.5%) and storage duration of 1 year (standard requires 2 years).

Signed: 

Name: Mark Jenkins

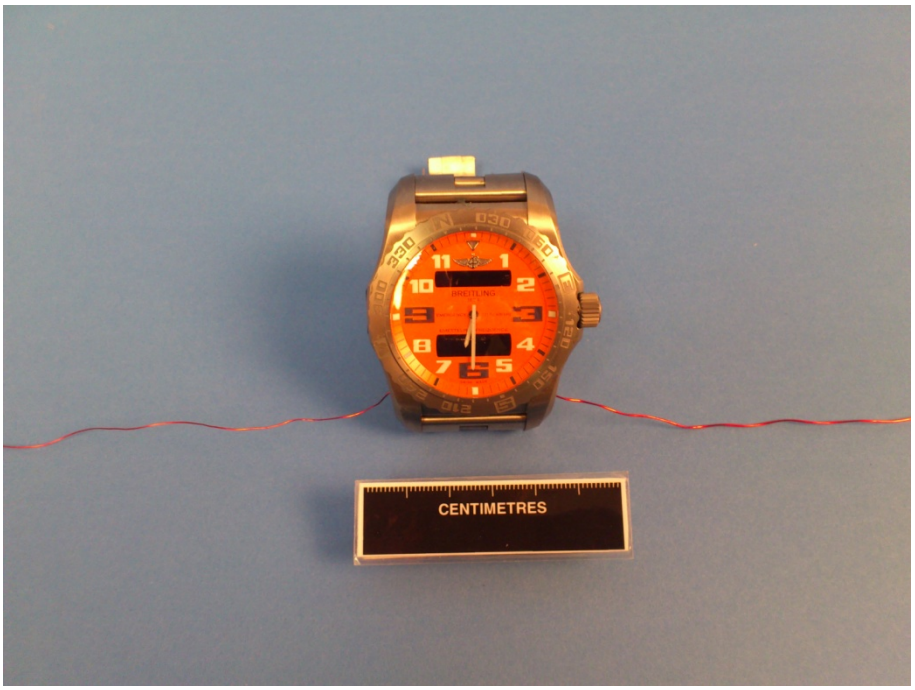
Position Held: Authorised Signatory

Date: 14 February 2014

1.3 PRODUCT INFORMATION

1.3.1 Technical Description

The Equipment Under Test (EUT) was a Breitling EMERGENCY 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 and Satellite Qualitative Tests.

The second EUT was a fully packaged beacon, similar to the proposed production beacons equipped with its proper antennae. This EUT was used to perform Antenna Characteristics and Satellite Qualitative Tests. 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.

The EUT is fitted with separate batteries to operate the watch and emergency beacon functions.

1.3.3 Modes of Operation

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

Off/Standby Mode

- LED – inactive, unless the internal battery level drops below a threshold level. (See notes below).

Self-test

- EUT placed in battery charger,
- List of items checked as per Customer Supplied Information (Application Form),
- Charger and EUT LED's indicate Self Test Pass or Fail.

Operating

- 406 and 121 antennae deployed,
- 121 Homer active (Note: The 121 homer is only active when the temperature is above a predetermined threshold level. Once the temperature falls below this level, the 121 homer deactivates to conserve battery power).

Notes

In Standby mode a red flashing LED will alert the end user that the EUT battery requires recharging if:

- the battery level drop below a safety threshold,
- OR the TBRC (Time Between Recommended Charges) time has expired.

The manufacturer has stated that the operating manual will clearly state that, should the user not recharge the battery when recommended, the operating lifetime performance of the EUT will be compromised.

To carry out a self-test, the EUT is placed in the supplied battery charger. When charging is complete, the charger and EUT LED's will indicate a successful self-test (green LED) or a self-test failure (red LED). Should a failure occur, the user will be advised to return the EUT to the manufacturer for servicing.

1.4 MODIFICATIONS

Modification State	Description of Modification still fitted to EUT	Modification Fitted By	Date Modification Fitted
Serial Number: M5			
0	As supplied by manufacturer.	N/A	N/A
1	Switch modification fitted to allow the EUT to be switched on and off for ease of testing.	Manufacturer	02/09/2013
2	Switch modification altered to allow the EUT to be switched on but NOT off for during testing. This modification state is reported to be the same as mod state 1 but with the register "Enable Quit distress mode" set to true => False. Further details to be provided by the manufacturer.	Manufacturer	05/09/2013

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.

1.5 REPORT MODIFICATION RECORD

Issue 1 – First Issue
Issue 2 – Operating lifetime tests added to the test exception list, modulation and VSWR results amended in summary table. Note added to summary table relating to effective lifetime. TCXO missing figures added to TCXO IP section.
Issue 3 – Changes in response to CS worksheet 4 including: battery current calculation adjustments, modification to the presentation of modulation results. Battery data sheet included. Operating lifetime duration change for the test run at 0 degrees.
Issue 4 – Changes in response to CS worksheet 5 including: a deviation note indicating the use of a power supply for current measurements. Operating lifetime figures adjusted due to account for changes to predischarge calculation.
Issue 5 – Operating Lifetime at -20°C noted as a Non-compliance on page 10 of this report and in the summary table.
Issue 6 – Reference to Operating Lifetime as a pass within measurement uncertainty removed from page 10 of this report. Manufacturer's battery cell data sheet revised as supplied by Manufacturer.
Issue 7 – Manufacturer battery cell data sheet removed from annex.

SECTION 2

TEST DETAILS

Emergency Beacons Testing of the
Breitling EMERGENCY

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**
Emergency S/N: M5, TUV Ref: TSR0001, Modification State 1							
Transmitter power output		35 - 39	dBm	35.22	35.75	36.11	All power Results include 0.1 dB EUT path loss.
Power output rise time		< 5	ms	0.012	0.008	0.022	
Power output 1ms before burst		< -10	dBm	-39.37	-44.5	-45.27	
2. Digital Message Coding							**Result: Pass**
Emergency S/N: M5, TUV Ref: TSR0001, Modification State 1							
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	0	0	0	
Protocol flag	26	1 bit	bit value	1	1	1	
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	000000	000000	000000	
Additional data / BCH (if applicable)	112 - 144	32 bits	P / F	N/A	N/A	N/A	
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**
Emergency S/N: M5, TUV Ref: TSR0001, Modification State 1						
Repetition rate, T_R:						
Average T_R	$48.5 \le T_{Ravg} \le 51.5$	seconds	49.33	49.33	49.33	
Minimum T_R	$47.5 \le T_{Rmin} \le 48.0$	seconds	47.89	47.89	47.87	
Maximum T_R	$52.0 \le T_{Rmax} \le 52.5$	seconds	52.07	52.04	52.04	
Standard deviation	0.5 - 2.0	seconds	1.63	1.62	1.63	
Bit rate						
Minimum fb	≥ 396	bits/sec	398.15	398.84	398.76	
Maximum fb	≤ 404	bits/sec	400.37	399.95	400.01	
Total transmission time						
Short message	435.6 - 444.4	ms	440.55	440.40	440.25	
Long message	514.8 - 525.2	ms	N/A	N/A	N/A	
Unmodulated carrier						
Minimum T1	≥ 158.4	ms	159.29	159.66	159.59	
Maximum T1	≤ 161.6	ms	160.20	160.07	160.10	
First burst delay	≥ 47.5	seconds	48	51	50	
4. Modulation						**Result: Non – compliant. (Pass within Measurement Uncertainty) See test results section**
Emergency S/N: M5, TUV Ref: TSR0001, Modification State 1						
Biphase-L	P / F	P / F	P	P	P	Phase Deviation outside C/S T.007 limits, however the results are within the test facility accuracy stated in T.008
Rise time (min and max)	50 - 250	µs	190.4 164.4	190.3 170.3	190.3 163.3	
Fall time (min and max)	50 - 250	µs	190.6 170.7	191.7 172.7	190.7 176.7	
Phase deviation: positive (min and max)	+(1.0 to 1.2)	radians	1.212 0.978	1.218 0.995	1.204 0.994	See plots in test results section.
Phase deviation: negative (min and max)	-(1.0 to 1.2)	radians	-1.217 -0.983	-1.203 -0.978	-1.211 -1.005	See plots in test results section.
Symmetry measurement	≤ 0.05		0.028	0.034	0.037	

Parameters to be Measured	Range of Specification	Units	Test Results			Comments
			Tmin	Tamb	Tmax	
			(-20°C)	(+21°C)	(+55°C)	
5. 406 MHz Transmitted Frequency						**Result: Pass**
Emergency S/N: M5, TUV Ref: TSR0001, Modification State 1						
Nominal Value	C/S T.001	MHz	406.0400017	406.0400054	406.0399887	
Short-term stability	≤ $2x10^{-9}$	/100ms	$7.989x10^{-10}$	$2.268x10^{-10}$	$1.699x10^{-10}$	
Medium-term stability – Slope	(-1 to +1)$x10^{-9}$	/minutes	$1.938x10^{-11}$	$1.429x10^{-11}$	$1.070x10^{-10}$	
Medium-term stability – Residual frequency variation	≤ $3x10^{-9}$		$6.086x10^{-10}$	$2.476x10^{-10}$	$3.827x10^{-10}$	
6. Spurious Emissions into 50ohms						**Result: Pass**
Emergency S/N: M5, TUV Ref: TSR0001, Modification State 1						
In band (406.0 – 406.1 MHz)	C/S T.001 mask	P / F	P			
7. 406 MHz VSWR Check						**Result: Non – compliant. (Pass within Measurement Uncertainty) See test results section**
Emergency S/N: M5, TUV Ref: TSR0001, Modification State 1						
Nominal transmitted frequency	C/S T.001	MHz	406.0400029	406.0400056	406.0399926	Phase Deviation outside C/S T.007 limits, however the results are within the test facility accuracy stated in T.008
Rise time (min and max)	50-250	µs	191.3 169.3	191.3 164.3	191.3 163.3	
Fall time (min and max)	50-250	µs	190.7 164.7	190.7 176.7	190.7 166.7	
Phase deviation: positive (min and max)	+ (1.0 to 1.2)	radians	1.230 0.984	1.208 0.962	1.225 1.011	See plots in test results section.
Phase deviation: negative (min and max)	- (1.0 to 1.2)	radians	-1.217 -0.967	-1.219 -1.000	-1.193 -0.978	See plots in test results section.
Modulation symmetry measurement	≤ 0.05		0.033	0.033	0.031	
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**
Emergency S/N: M5, TUV Ref: TSR0001, Modification State 1						
Frame sync	011010000	P / F	P	P	P	Applicant's data: See Annex A
Format flag	1 / 0	bit value	0	0	0	
Single radiated burst	≤440 / 520 (±1%)	ms	440.52	439.780	440.40	
Default position data (if applicable)	correct	P / F	N/A	N/A	N/A	
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	

Parameters to be Measured	Range of Specification	Units	Test Results		Comments
9. Thermal Shock					**Result: Pass**
Emergency S/N: M5, TUV Ref: TSR0001, Modification State 1					
Soak Temperature	30°C difference	°C	20.0		
Measurement Temperature		°C	-10.0		
Transmitted Frequency			Min	Max	
Nominal value	C/S T.001	MHz	406.0400086	406.0400099	
Short-term stability	≤ $2x10^{-9}$	/100ms	$3.935x10^{-10}$	$5.782x10^{-10}$	
Medium-term stability – Slope	(-2 to +2)$x10^{-9}$	/min	$-2.396x10^{-10}$	$1.389x10^{-10}$	
Medium-term stability – Residual frequency variation	≤ $3x10^{-9}$		$3.603x10^{-10}$	$5.512x10^{-10}$	
Transmitter power output	35 - 39	dBm	35.42	35.47	All power Results include 0.1 dB EUT path loss.
Digital message	correct	P/F	P		

Parameters to be Measured	Range of Specification	Units	Test Results		Comments
10. Operating Lifetime at Minimum Temperature					**Result: Non – compliant**
Emergency S/N: M5, TUV Ref: TSR0001, Modification State 2					
Pre-test battery discharge duration (operating) required		Hours	1.68		
Pre-test battery discharge duration (operating)		Hours	1.42		
Duration	>24	Hours	23.66 Hours at Tmin = -20°C		
Effective Operating Lifetime duration	>24	Hours	20.57* Hours at Tmin = -20°C		This result is exclusive of the 0.5 dB Measurement Uncertainty figure stated in C/S T.008. With the application of MU, the effective lifetime was recorded as 22.00 hours.
Transmitted Frequency			Min	Max	
Nominal value	C/S T.001	MHz	406.0399989	406.0400092	
Short-term stability	≤ $2x10^{-9}$	/100ms	$4.329x10^{-10}$	$9.843x10^{-10}$	
Medium-term stability – Slope	(-1 to +1)$x10^{-9}$	/min	$-1.46x10^{-10}$	$1.23x10^{-10}$	
Medium-term stability – Residual frequency variation	≤ $3x10^{-9}$		$2.38x10^{-10}$	$6.88x10^{-10}$	
Transmitter power output	35 - 39	dBm	34.50	35.58	All power Results include 0.1 dB EUT path loss. Minimum output power outside C/S T.007 limits, however the results are within the test facility accuracy stated in T.008.
Digital message	correct	P/F	P		
Homer transmitter continuous operation during the lifetime test		hours	N/A		
			Start of Test	End of Test	
Homer frequency		MHz	N/A	N/A	Homing transmitter was not active at the test temperature
Homer peak power level		dBm	N/A	N/A	
Homer transmitter duty cycle		%	N/A	N/A	

* Due to a modification (increase) in the predischarge calculation, the effective operating lifetime duration has been adjusted as follows:

Additional discharge required: 66.42mA-hrs. Average operating current at -20°C = 21.48mA. 66.42/21.48 = 3.09 hours.

Therefore this additional figure has been reduced by this amount (23.66 – 3.09 = 20.57 hours).

Parameters to be Measured	Range of Specification	Units	Test Results		Comments
10. Operating Lifetime at 0°C (Additional Test)					**Result: Non – compliant**
Emergency S/N: M5, TUV Ref: TSR0001, Modification State 2					
Pre-test battery discharge duration (operating) required		Hours	1.68		
Pre-test battery discharge duration (operating)		Hours	1.42		
Duration	>24	Hours	21.95 Hours at Tmin = 0°C		
Effective Operating Lifetime duration	>24	Hours	18.93* Hours at Tmin = 0°C		Test duration did not meet the specification limit of 24 h
Transmitted Frequency			Min	Max	
Nominal value	C/S T.001	MHz	406.0400079	406.0400162	
Short-term stability	≤ $2x10^{-9}$	/100ms	$1.218x10^{-10}$	$2.84x10^{-10}$	
Medium-term stability – Slope	(-1 to +1)$x10^{-9}$	/min	$-5.36x10^{-11}$	$9.37x10^{-11}$	
Medium-term stability – Residual frequency variation	≤ $3x10^{-9}$		$3.31x10^{-10}$	$7.20x10^{-10}$	
					All power Results include 0.1 dB EUT path loss.
Transmitter power output	35 - 39	dBm	34.51	35.64	Minimum output power outside C/S T.007 limits, however the results are within the test facility accuracy stated in T.008.
Digital message	correct	P/F	P		
Homer transmitter continuous operation during the lifetime test		hours	N/A		
			Start of Test	End of Test	
Homer frequency		MHz	121.50	121.50	
Homer peak power level		dBm	16.71	16.71	
Homer transmitter duty cycle		%	32.7	33.1	

* Due to a modification (increase) in the predischarge calculation, the effective operating lifetime duration has been adjusted as follows:

Additional discharge required: 66.42mA-hrs. Average operating current at -5°C (worst case as no figures available at 0°C = 22.00mA. 66.42/22.00 = 3.02 hours.

Therefore this additional figure has been reduced by this amount (21.95 – 3.02 = 18.93 hours).

Parameters to be Measured	Range of Specification	Units	Test Results		Comments
11. Temperature Gradient (5°C/hr)					**Result: Pass**
Emergency S/N: M5, TUV Ref: TSR0001, Modification State 1					
Up Ramp					
Transmitted Frequency			Min	Max	
Nominal value	C/S T.007	MHz	406.0399965	4060400168	
Short-term stability	≤ $2x10^{-9}$	/100ms	$1.17x10^{-10}$	$9.89x10^{-10}$	
Medium-term stability – Slope[1]	(-1 to +1)$x10^{-9}$	/min	$-1.01x10^{-10}$	$1.29x10^{-10}$	Data for points A to B and C+15 to D
	(-2 to +2)$x10^{-9}$	/min	$-1.71x10^{-10}$	$4.21x10^{-10}$	Data for points B to C+15 min
Medium-term stability – Residual frequency variation	≤ $3x10^{-9}$		$2.02x10^{-10}$	$1.02x10^{-9}$	
Transmitter power output	35 – 39	dBm	35.27	36.27	All power Results include 0.1 dB EUT path loss.
Digital message	correct	P/F	P		
Emergency S/N: M5, TUV Ref: TSR0001, Modification State 2					
Down Ramp					
Transmitted Frequency			Min	Max	
Nominal value	C/S T.007	MHz	406.0399910	406.0400111	
Short-term stability	≤ $2x10^{-9}$	/100ms	$9.591x10^{-11}$	$8.789x10^{-10}$	
Medium-term stability – Slope[1]	(-1 to +1)$x10^{-9}$	/min	$-5.73x10^{-11}$	$2.55x10^{-10}$	Data for points C to D, E + 15 min to F
	(-2 to +2)$x10^{-9}$	/min	$-2.09x10^{-10}$	$2.54x10^{-10}$	Data for points D to E + 15 min
Medium-term stability – Residual frequency variation	≤ $3x10^{-9}$		$1.338x10^{-10}$	$1.059x10^{-9}$	
Transmitter power output	35 – 39	dBm	35.40	36.18	All power Results include 0.1 dB EUT path loss.
Digital message	correct	P/F	P		
12. Oscillator Aging					
Data	provided	Y / N	Y		Applicant's data: Annex A
13. Protection Against Continuous Transmission					
Description	provided	Y / N	Y		Applicant's data: Annex A

Parameters to be Measured	Range of Specification	Units	Test Results				Comments
14. Satellite Qualitative Tests							**Result: Pass**
Emergency S/N: M1, TUV Ref: TSR0002, Modification State 0 (EUT fitted with Metal Strap)							
Test Configuration	As per C/S T.007		Configuration				
			5	6	7	8	
15 Hex ID Decoded by LUT	correct	P / F	-	-	-	P	
Doppler Location results with error ≤5km	≥80	%	-	-	-	88.2	
Emergency S/N: M1, TUV Ref: TSR0002, Modification State 0 (EUT fitted with Rubber Strap)							
Test Configuration	As per C/S T.007		Configuration				
			5	6	7	8	
15 Hex ID Decoded by LUT	correct	P / F	-	-	-	P	
Doppler Location results with error ≤5km	≥80	%	-	-	-	93.7	
15. Antenna Characteristics							**Result: Pass**
Emergency S/N: M1, TUV Ref: TSR0002, Modification State 0 (EUT fitted with Metal Strap)							
Test Configuration	As per C/S T.007		Configuration				
			1	2	3	4	
Polarisation	linear or RHCP		-	-	-	Linear	
VSWR	≤1.5		-	-	-	N/A	Detachable Antennas Only
$EIRP_{LOSS}$		dB	-	-	-	1.25	
$EIRP_{maxEOL}$	≤43	dBm	-	-	-	40.6	
$EIRP_{minEOL}$	≥32	dBm	-	-	-	31.7	$EIRP_{minEOL}$ limit decreases to 30 dBm for Configuration 4
Emergency S/N: M1, TUV Ref: TSR0002, Modification State 0 (EUT fitted with Rubber Strap)							
Test Configuration	As per C/S T.007		Configuration				
			1	2	3	4	
Polarisation	linear or RHCP		-	-	-	Linear	
VSWR	≤1.5		-	-	-	N/A	Detachable Antennas Only
$EIRP_{LOSS}$		dB	-	-	-	1.25	
$EIRP_{maxEOL}$	≤43	dBm	-	-	-	39.3	
$EIRP_{minEOL}$	≥32	dBm	-	-	-	32.0	$EIRP_{minEOL}$ limit decreases to 30 dBm for Configuration 4

Parameters to be Measured	Range of Specification	Units	Test Results	Comments
16. Beacon Coding Software				**Result: Pass**
Emergency S/N: M5, TUV Ref: TSR0001, Modification State 1				
Sample message for each coding option of the applicable coding types	correct	P / F	P	
Sample self-test message for each coding option of the applicable coding types	correct	P / F	P	

2.1 DIGITAL MESSAGE

2.1.1 Specification

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

2.1.2 Equipment Under Test and Modification State

Emergency, S/N: M5 - Modification State 1

2.1.3 Date of Test

3 September 2013 & 16 September 2013

2.1.4 Test Equipment Used

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

2.1.5 Environmental Conditions

Ambient Temperature 21.5 °C - 22.0 °C
Relative Humidity 41.7 % - 66.2 %

2.1.6 Test Results

Ambient Temperature

```
Beacon Id Format..... 22 Hex Id, Short Message, Bits 25-112
 15 Hex (Bits 26- 85) = AA4F0E1A4000001              AA4F0E1A4000001 Default_Id
 30 Hex (Bits 25-144) = 5527870D2000000BB31B8000000000

   26   30   34   38   42   46   50   54   58   62   66   70   74   78   82
   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
 0 1010 1010 0100 1111 0000 1110 0001 1010 0100 0000 0000 0000 0000 0000 0001
   0111 0110 0110 0011 0111 0000 0000 0000 0000 0000 0000 0000 0000 0000 000
   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
   86   90   94   98  102  106  110  114  118  122  126  130  134  138  142

Field Name        Bit Pos    Value Decode                                 Bits
----------        -------    ----- ------                                 ----
Format Flag        25            0 Short Message                             0
Protocol Flag      26            1 User                                      1
MID                27- 36      338 HAWAII                          0101 0100 10
User Protocol      37- 39        3 Serialized                           011
Beacon type        40- 42        6 Personal/ PLB                        110
Certification type 43            0 National                                0
Serial Number      44- 63   231056                      0011 1000 0110 1001 0000
National Use       64- 83        0                      0000 0000 0000 0000 0000
Manufacturer       44- 51       56 Unknown         NON-SPEC             0011 1000
Sequence Number    52- 63     1680                               0110 1001 0000
Model              64- 67        0                                     0000
Production Run     68- 75        0                                0000 0000
U.S. Spare         76- 83        0 Hex=00                         0000 0000
Homing             84- 85        1 121.5                                 01
BCH Encoded        86-106          Errors=0           0111 0110 0110 0011 0111 0
BCH Generated      86-106                             0111 0110 0110 0011 0111 0
Emergency Cd Flag 107            0 National Use                            0
Beacon Activation 108            0 Manual only                             0
National Use      109-112                                                0000
```

Low Temperature

```
Beacon Id Format..... 22 Hex Id, Short Message, Bits 25-112
 15 Hex (Bits 26- 85) = AA4F0E1A4000001              AA4F0E1A4000001 Default_Id
 30 Hex (Bits 25-144) = 5527870D2000000BB31B8000000000

   26   30   34   38   42   46   50   54   58   62   66   70   74   78   82
   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
 0 1010 1010 0100 1111 0000 1110 0001 1010 0100 0000 0000 0000 0000 0000 0001
   0111 0110 0110 0011 0111 0000 0000 0000 0000 0000 0000 0000 0000 0000 000
   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
   86   90   94   98  102  106  110  114  118  122  126  130  134  138  142

Field Name        Bit Pos    Value Decode                                  Bits
----------        -------    ----- ------                                  ----
Format Flag        25            0 Short Message                              0
Protocol Flag      26            1 User                                       1
MID                27- 36      338 HAWAII                          0101 0100 10
User Protocol      37- 39        3 Serialized                            011
Beacon type        40- 42        6 Personal/ PLB                         110
Certification type 43            0 National                                 0
Serial Number      44- 63   231056                      0011 1000 0110 1001 0000
National Use       64- 83        0                      0000 0000 0000 0000 0000
Manufacturer       44- 51       56 Unknown         NON-SPEC            0011 1000
Sequence Number    52- 63     1680                               0110 1001 0000
Model              64- 67        0                                       0000
Production Run     68- 75        0                                 0000 0000
U.S. Spare         76- 83        0 Hex=00                          0000 0000
Homing             84- 85        1 121.5                                 01
BCH Encoded        86-106          Errors=0           0111 0110 0110 0011 0111 0
BCH Generated      86-106                             0111 0110 0110 0011 0111 0
Emergency Cd Flag 107            0 National Use                             0
Beacon Activation 108            0 Manual only                              0
National Use      109-112                                                0000
```

High Temperature

```
Beacon Id Format..... 22 Hex Id, Short Message, Bits 25-112
 15 Hex (Bits 26- 85) = AA4F0E1A4000001              AA4F0E1A4000001 Default_Id
 30 Hex (Bits 25-144) = 5527870D2000000BB31B8000000000

   26   30   34   38   42   46   50   54   58   62   66   70   74   78   82
   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
 0 1010 1010 0100 1111 0000 1110 0001 1010 0100 0000 0000 0000 0000 0000 0001
   0111 0110 0110 0011 0111 0000 0000 0000 0000 0000 0000 0000 0000 0000 000
   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
   86   90   94   98  102  106  110  114  118  122  126  130  134  138  142

Field Name        Bit Pos    Value Decode                                  Bits
----------        -------    ----- ------                                  ----
Format Flag        25            0 Short Message                             0
Protocol Flag      26            1 User                                      1
MID                27- 36      338 HAWAII                          0101 0100 10
User Protocol      37- 39        3 Serialized                           011
Beacon type        40- 42        6 Personal/ PLB                        110
Certification type 43            0 National                                0
Serial Number      44- 63   231056                      0011 1000 0110 1001 0000
National Use       64- 83        0                      0000 0000 0000 0000 0000
Manufacturer       44- 51       56 Unknown         NON-SPEC            0011 1000
Sequence Number    52- 63     1680                               0110 1001 0000
Model              64- 67        0                                      0000
Production Run     68- 75        0                                 0000 0000
U.S. Spare         76- 83        0 Hex=00                          0000 0000
Homing             84- 85        1 121.5                                 01
BCH Encoded        86-106          Errors=0           0111 0110 0110 0011 0111 0
BCH Generated      86-106                             0111 0110 0110 0011 0111 0
Emergency Cd Flag 107            0 National Use                            0
Beacon Activation 108            0 Manual only                             0
National Use      109-112                                                0000
```

2.2 MODULATION

2.2.1 Specification

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

2.2.2 Equipment Under Test and Modification State

Emergency, S/N: M5 - Modification State 1

2.2.3 Date of Test

3 September 2013 & 16 September 2013

2.2.4 Test Equipment Used

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

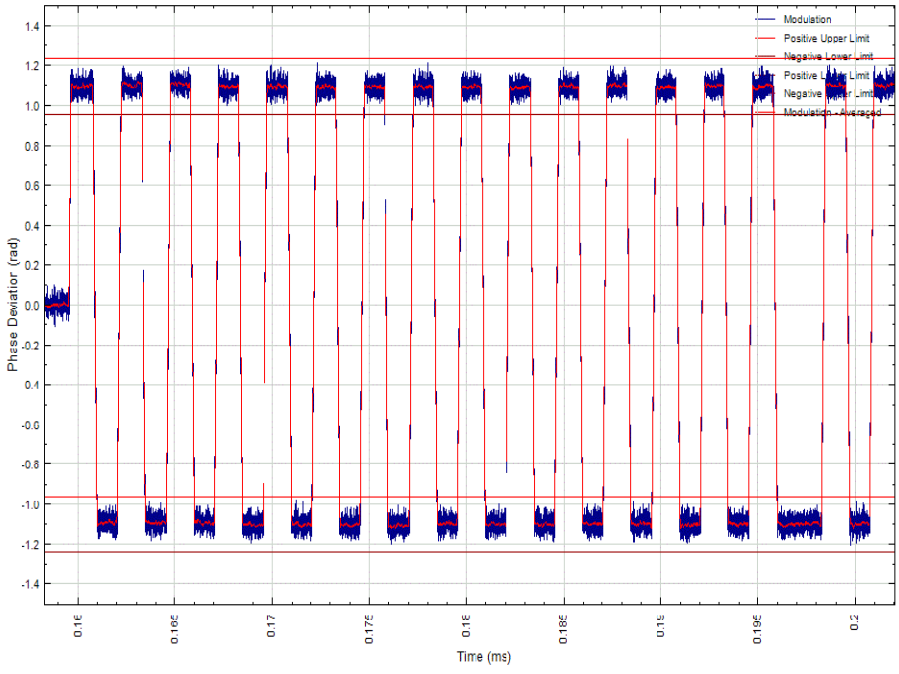
2.2.5 Environmental Conditions

Ambient Temperature 20.7 °C - 22.0 °C
Relative Humidity 41.7 % - 60.7 %

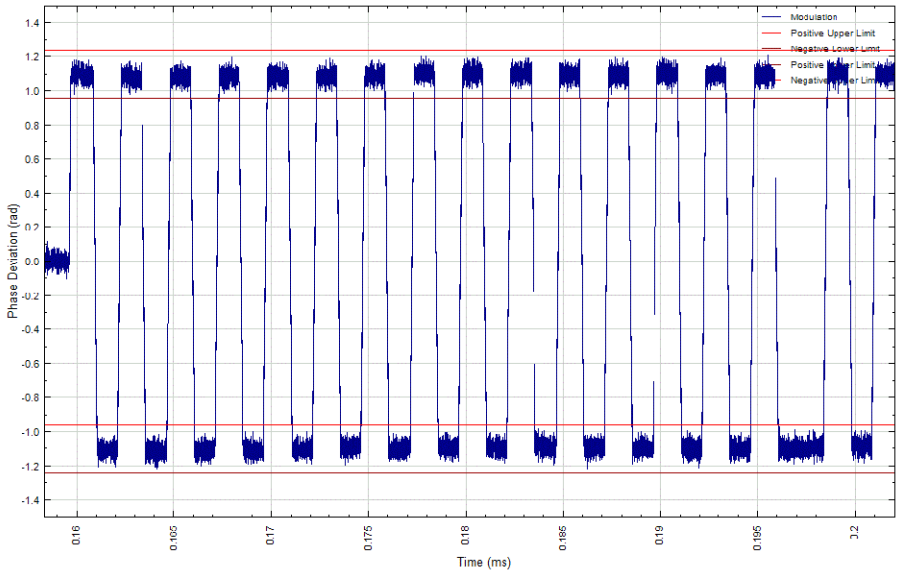
2.2.6 Test Results

Note: The limits lines shown in the result plots include the test house facility accuracy stated in T.008 of ±0.04 radians.

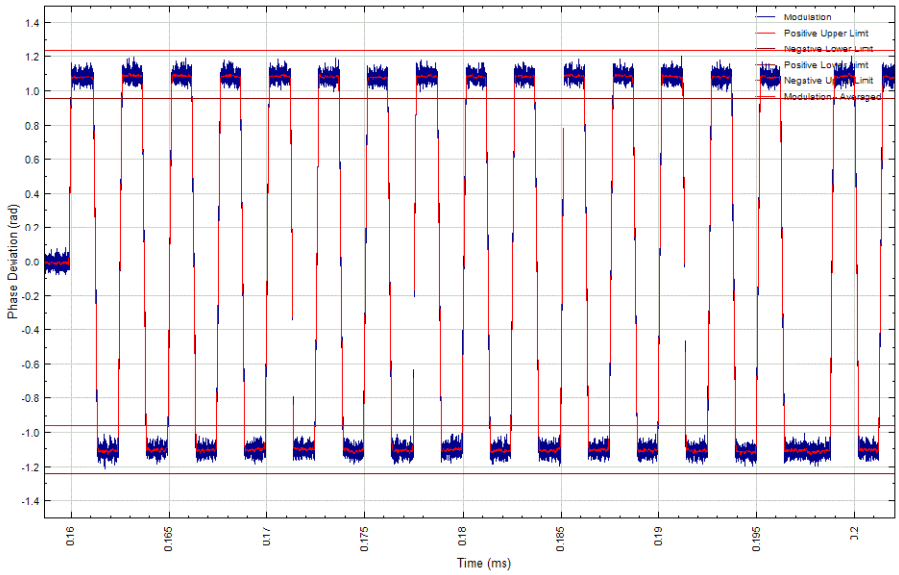
Ambient Temperature



Low Temperature



High Temperature



Phase Deviation at Ambient, +55 °C and -20 °C outside C/S T.007 limits; however, the results are within the test facility accuracy stated in T.008.

2.3 SPURIOUS EMISSION INTO 50 OHMS

2.3.1 Specification

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

2.3.2 Equipment Under Test and Modification State

Emergency, S/N: M5 - Modification State 1

2.3.3 Date of Test

12 and 13 September 2013

2.3.4 Test Equipment Used

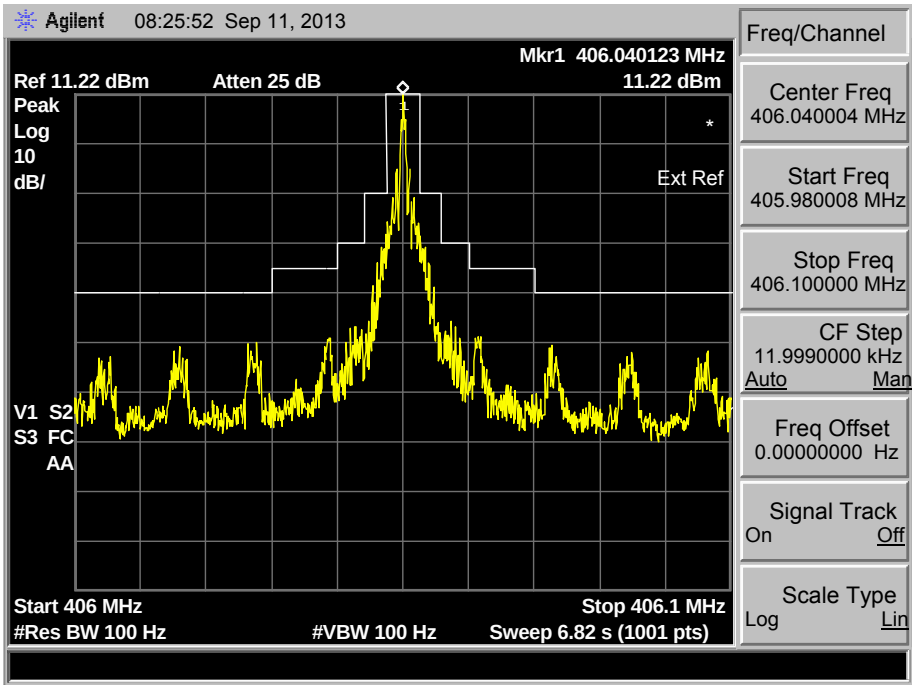
The major items of test equipment used for the above tests are identified in Section 3.1.

2.3.5 Environmental Conditions

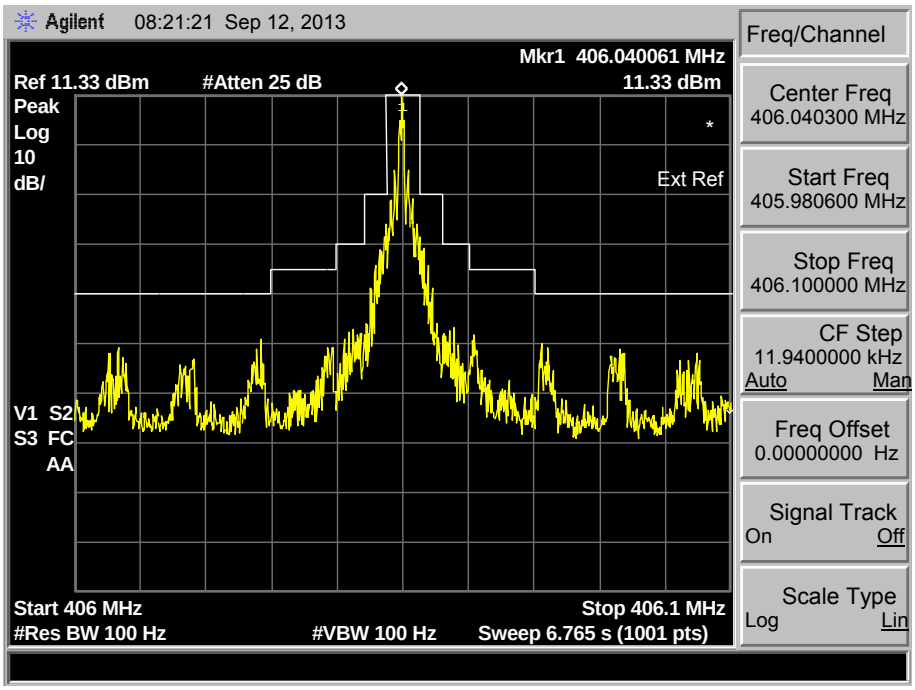
Ambient Temperature 22.8 °C
Relative Humidity 56.2 %

2.3.6 Test Results

Combined Ambient and High Temperature



Low Temperature



2.4 406 MHz VSWR CHECK

2.4.1 Specification

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

2.4.2 Equipment Under Test and Modification State

Emergency, S/N: M5 - Modification State 1

2.4.3 Date of Test

3 September 2013 & 16 September 2013

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

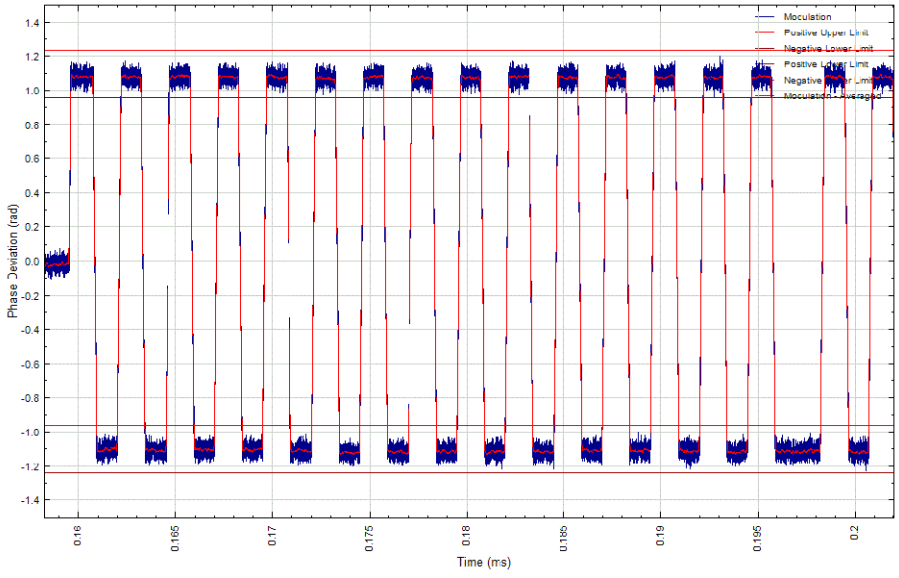
Ambient Temperature 20.6 °C - 22.0 °C
Relative Humidity 41.7 % - 57.7 %

2.4.6 Test Results

Note: The limits lines shown in the result plots include the test house facility accuracy stated in T.008 of ±0.04 radians.

Ambient Temperature

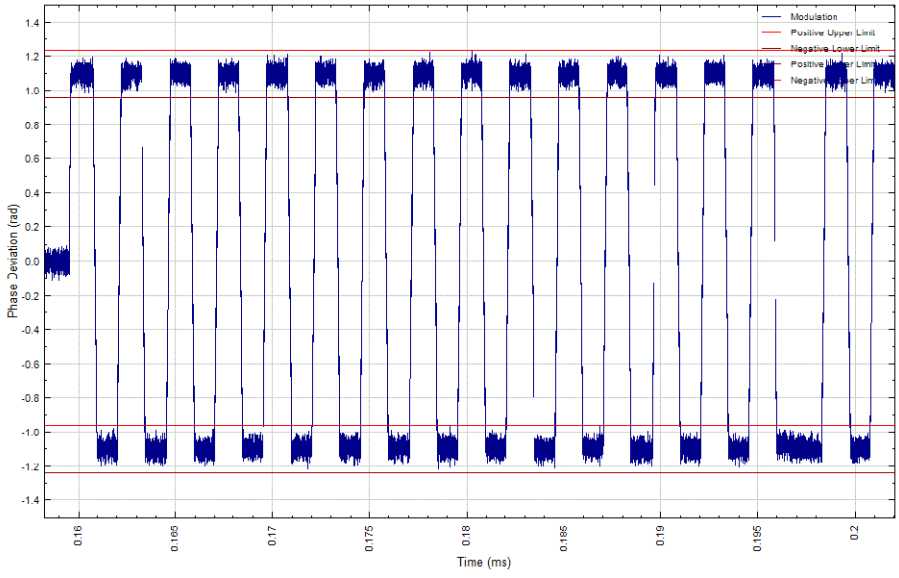
```
Beacon Id Format..... 22 Hex Id, Short Message, Bits 25-112
 15 Hex (Bits 26- 85) = AA4F0E1A4000001              AA4F0E1A4000001 Default_Id
 30 Hex (Bits 25-144) = 5527870D2000000BB31B8000000000

   26   30   34   38   42   46   50   54   58   62   66   70   74   78   82
   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
 0 1010 1010 0100 1111 0000 1110 0001 1010 0100 0000 0000 0000 0000 0000 0001
   0111 0110 0110 0011 0111 0000 0000 0000 0000 0000 0000 0000 0000 0000 000
   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
   86   90   94   98  102  106  110  114  118  122  126  130  134  138  142

Field Name        Bit Pos    Value Decode                                  Bits
----------        -------    ----- ------                                  ----
Format Flag        25            0 Short Message                              0
Protocol Flag      26            1 User                                       1
MID                27- 36      338 HAWAII                           0101 0100 10
User Protocol      37- 39        3 Serialized                            011
Beacon type        40- 42        6 Personal/ PLB                         110
Certification type 43            0 National                                   0
Serial Number      44- 63   231056                      0011 1000 0110 1001 0000
National Use       64- 83        0                      0000 0000 0000 0000 0000
Manufacturer       44- 51       56 Unknown          NON-SPEC             0011 1000
Sequence Number    52- 63     1680                               0110 1001 0000
Model              64- 67        0                                        0000
Production Run     68- 75        0                                0000 0000
U.S. Spare         76- 83        0 Hex=00                         0000 0000
Homing             84- 85        1 121.5                                    01
BCH Encoded        86-106          Errors=0           0111 0110 0110 0011 0111 0
BCH Generated      86-106                             0111 0110 0110 0011 0111 0
Emergency Cd Flag 107            0 National Use                               0
Beacon Activation 108            0 Manual only                                0
National Use      109-112                                                  0000
```



Low Temperature

```
Beacon Id Format......... 22 Hex Id, Short Message, Bits 25-112
 15 Hex (Bits 26- 85) = AA4F0E1A4000001              AA4F0E1A4000001 Default_Id
 30 Hex (Bits 25-144) = 5527870D2000000BB31B8000000000

   26   30   34   38   42   46   50   54   58   62   66   70   74   78   82
   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
 0 1010 1010 0100 1111 0000 1110 0001 1010 0100 0000 0000 0000 0000 0000 0001
   0111 0110 0110 0011 0111 0000 0000 0000 0000 0000 0000 0000 0000 0000 000
   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
   86   90   94   98  102  106  110  114  118  122  126  130  134  138  142
```

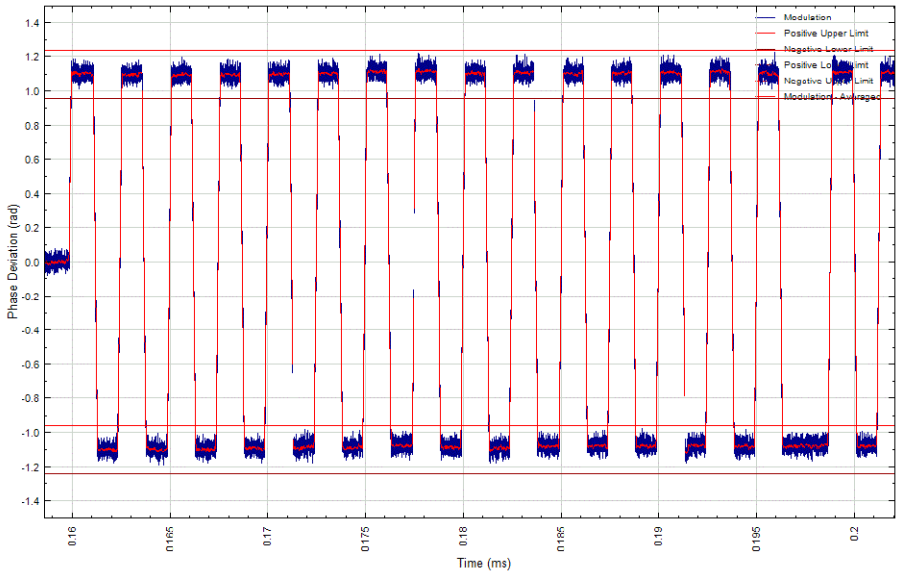
Field Name	Bit Pos	Value	Decode		Bits
Format Flag	25	0	Short Message		0
Protocol Flag	26	1	User		1
MID	27- 36	338	HAWAII	0101 0100 10	
User Protocol	37- 39	3	Serialized		011
Beacon type	40- 42	6	Personal/ PLB		110
Certification type	43	0	National		0
Serial Number	44- 63	231056		0011 1000 0110 1001 0000	
National Use	64- 83	0		0000 0000 0000 0000 0000	
Manufacturer	44- 51	56	Unknown	NON-SPEC	0011 1000
Sequence Number	52- 63	1680		0110 1001 0000	
Model	64- 67	0			0000
Production Run	68- 75	0		0000 0000	
U.S. Spare	76- 83	0	Hex=00	0000 0000	
Homing	84- 85	1	121.5		01
BCH Encoded	86-106		Errors=0	0111 0110 0110 0011 0111 0	
BCH Generated	86-106			0111 0110 0110 0011 0111 0	
Emergency Cd Flag	107	0	National Use		0
Beacon Activation	108	0	Manual only		0
National Use	109-112				0000



High Temperature

```
Beacon Id Format..... 22 Hex Id, Short Message, Bits 25-112
 15 Hex (Bits 26- 85) = AA4F0E1A4000001              AA4F0E1A4000001 Default_Id
 30 Hex (Bits 25-144) = 5527870D2000000BB31B8000000000

   26   30   34   38   42   46   50   54   58   62   66   70   74   78   82
   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
 0 1010 1010 0100 1111 0000 1110 0001 1010 0100 0000 0000 0000 0000 0000 0001
   0111 0110 0110 0011 0111 0000 0000 0000 0000 0000 0000 0000 0000 0000 000
   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
   86   90   94   98  102  106  110  114  118  122  126  130  134  138  142
```

Field Name	Bit Pos	Value	Decode		Bits
Format Flag	25	0	Short Message		0
Protocol Flag	26	1	User		1
MID	27- 36	338	HAWAII	0101 0100 10	
User Protocol	37- 39	3	Serialized		011
Beacon type	40- 42	6	Personal/ PLB		110
Certification type	43	0	National		0
Serial Number	44- 63	231056		0011 1000 0110 1001 0000	
National Use	64- 83	0		0000 0000 0000 0000 0000	
Manufacturer	44- 51	56	Unknown	NON-SPEC	0011 1000
Sequence Number	52- 63	1680		0110 1001 0000	
Model	64- 67	0			0000
Production Run	68- 75	0		0000 0000	
U.S. Spare	76- 83	0	Hex=00	0000 0000	
Homing	84- 85	1	121.5		01
BCH Encoded	86-106		Errors=0	0111 0110 0110 0011 0111 0	
BCH Generated	86-106			0111 0110 0110 0011 0111 0	
Emergency Cd Flag	107	0	National Use		0
Beacon Activation	108	0	Manual only		0
National Use	109-112				0000



Phase Deviation at Ambient, +55°C and -20°C outside C/S T.007 limits, however the results are within the test facility accuracy stated in T.008.

2.5 SELF-TEST MODES

2.5.1 Specification

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

2.5.2 Equipment Under Test and Modification State

Emergency, S/N: M5 - Modification State 1

2.5.3 Date of Test

16 September 2013

2.5.4 Test Equipment Used

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

2.5.5 Environmental Conditions

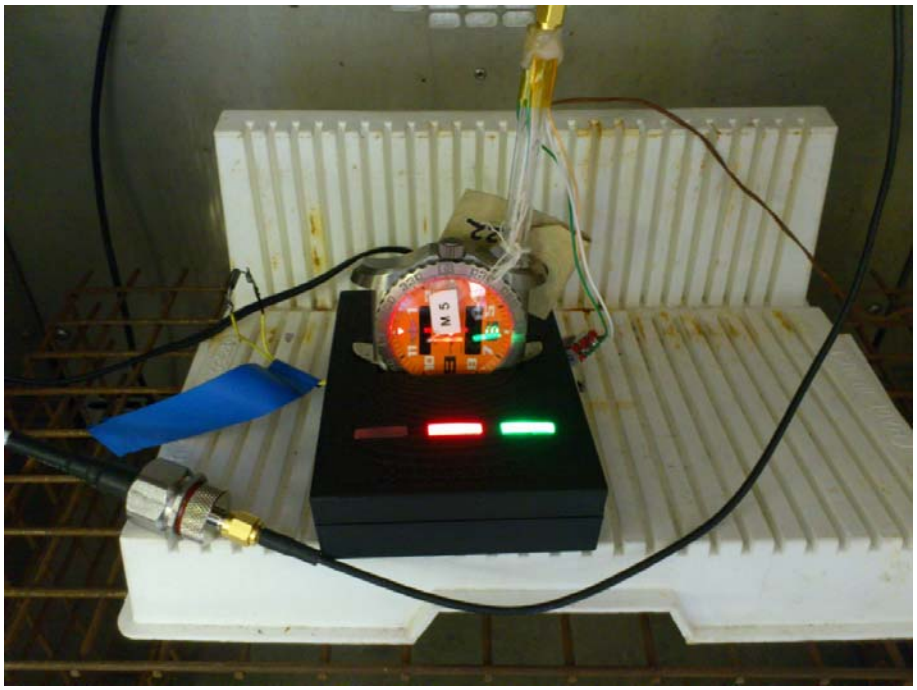
Ambient Temperature 22.0 °C
Relative Humidity 47.1 %

2.5.6 Test Results

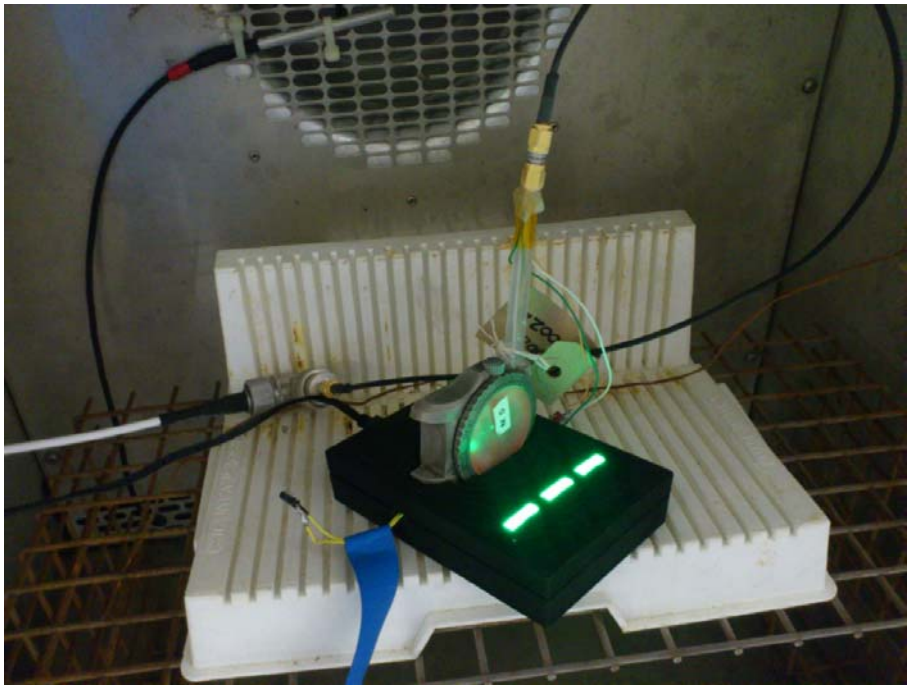
Self-test can only be performed by placing the EUT into the supplied charging unit. When charging the charging unit displays one green LED to indicate AC power is supplied, and one red LED to indicate charging is taking place. The third LED remains off. When charging is complete, a self-test is performed by the EUT. All three LEDs are illuminated green if the self-test is successful (plus the LED on the EUT is illuminated green).

If the self-test fails, the third LED on the charger and the EUT LED are illuminated red.

See example photographs below:



EUT charging



EUT fully charged – Self-Test Pass

Ambient temperature

```
Beacon Id Format..... 22 Hex Id, Short Message, Bits 25-112
 15 Hex (Bits 26- 85) = AA4F0E1A4000001              AA4F0E1A4000001 Default_Id
 30 Hex (Bits 25-144) = 5527870D2000000BB31B8000000000

   26   30   34   38   42   46   50   54   58   62   66   70   74   78   82
   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
 0 1010 1010 0100 1111 0000 1110 0001 1010 0100 0000 0000 0000 0000 0000 0001
   0111 0110 0110 0011 0111 0000 0000 0000 0000 0000 0000 0000 0000 0000 000
   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
   86   90   94   98  102  106  110  114  118  122  126  130  134  138  142

Field Name        Bit Pos    Value Decode                                  Bits
----------        -------    ----- ------                                  ----
Format Flag        25            0 Short Message                              0
Protocol Flag      26            1 User                                       1
MID                27- 36      338 HAWAII                          0101 0100 10
User Protocol      37- 39        3 Serialized                           011
Beacon type        40- 42        6 Personal/ PLB                        110
Certification type 43            0 National                                 0
Serial Number      44- 63   231056                      0011 1000 0110 1001 0000
National Use       64- 83        0                      0000 0000 0000 0000 0000
Manufacturer       44- 51       56 Unknown         NON-SPEC            0011 1000
Sequence Number    52- 63     1680                               0110 1001 0000
Model              64- 67        0                                      0000
Production Run     68- 75        0                                 0000 0000
U.S. Spare         76- 83        0 Hex=00                          0000 0000
Homing             84- 85        1 121.5                                  01
BCH Encoded        86-106          Errors=0           0111 0110 0110 0011 0111 0
BCH Generated      86-106                             0111 0110 0110 0011 0111 0
Emergency Cd Flag 107            0 National Use                             0
Beacon Activation 108            0 Manual only                              0
National Use      109-112                                                0000
```

Low temperature

```
Beacon Id Format..... 22 Hex Id, Short Message, Bits 25-112
 15 Hex (Bits 26- 85) = AA4F0E1A4000001              AA4F0E1A4000001 Default_Id
 30 Hex (Bits 25-144) = 5527870D2000000BB31B8000000000

   26   30   34   38   42   46   50   54   58   62   66   70   74   78   82
   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
 0 1010 1010 0100 1111 0000 1110 0001 1010 0100 0000 0000 0000 0000 0000 0001
   0111 0110 0110 0011 0111 0000 0000 0000 0000 0000 0000 0000 0000 0000 000
   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
   86   90   94   98  102  106  110  114  118  122  126  130  134  138  142

Field Name        Bit Pos    Value Decode                                 Bits
----------        -------    ----- ------                                 ----
Format Flag        25            0 Short Message                             0
Protocol Flag      26            1 User                                      1
MID                27- 36      338 HAWAII                          0101 0100 10
User Protocol      37- 39        3 Serialized                            011
Beacon type        40- 42        6 Personal/ PLB                         110
Certification type 43            0 National                                0
Serial Number      44- 63   231056                      0011 1000 0110 1001 0000
National Use       64- 83        0                      0000 0000 0000 0000 0000
Manufacturer       44- 51       56 Unknown         NON-SPEC            0011 1000
Sequence Number    52- 63     1680                              0110 1001 0000
Model              64- 67        0                                      0000
Production Run     68- 75        0                                 0000 0000
U.S. Spare         76- 83        0 Hex=00                          0000 0000
Homing             84- 85        1 121.5                                 01
BCH Encoded        86-106          Errors=0          0111 0110 0110 0011 0111 0
BCH Generated      86-106                            0111 0110 0110 0011 0111 0
Emergency Cd Flag 107            0 National Use                            0
Beacon Activation 108            0 Manual only                             0
National Use      109-112                                                0000
```

High temperature

```
Beacon Id Format......... 22 Hex Id, Short Message, Bits 25-112
 15 Hex (Bits 26- 85) = AA4F0E1A4000001              AA4F0E1A4000001 Default_Id
 30 Hex (Bits 25-144) = 5527870D2000000BB31B8000000000

   26   30   34   38   42   46   50   54   58   62   66   70   74   78   82
   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
 0 1010 1010 0100 1111 0000 1110 0001 1010 0100 0000 0000 0000 0000 0000 0001
   0111 0110 0110 0011 0111 0000 0000 0000 0000 0000 0000 0000 0000 0000 000
   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
   86   90   94   98  102  106  110  114  118  122  126  130  134  138  142

Field Name        Bit Pos    Value Decode                                  Bits
----------        -------    ----- ------                                  ----
Format Flag        25            0 Short Message                              0
Protocol Flag      26            1 User                                       1
MID                27- 36      338 HAWAII                          0101 0100 10
User Protocol      37- 39        3 Serialized                            011
Beacon type        40- 42        6 Personal/ PLB                         110
Certification type 43            0 National                                 0
Serial Number      44- 63   231056                      0011 1000 0110 1001 0000
National Use       64- 83        0                      0000 0000 0000 0000 0000
Manufacturer       44- 51       56 Unknown         NON-SPEC            0011 1000
Sequence Number    52- 63     1680                               0110 1001 0000
Model              64- 67        0                                     0000
Production Run     68- 75        0                                0000 0000
U.S. Spare         76- 83        0 Hex=00                         0000 0000
Homing             84- 85        1 121.5                                01
BCH Encoded        86-106          Errors=0           0111 0110 0110 0011 0111 0
BCH Generated      86-106                             0111 0110 0110 0011 0111 0
Emergency Cd Flag 107            0 National Use                             0
Beacon Activation 108            0 Manual only                              0
National Use      109-112                                                0000
```

2.6 THERMAL SHOCK

2.6.1 Specification

Cospas-Sarsat T.007, Clause A.2.2

2.6.2 Equipment Under Test and Modification State

Emergency, S/N: M5 - Modification State 1

2.6.3 Date of Test

13 September 2013

2.6.4 Test Equipment Used

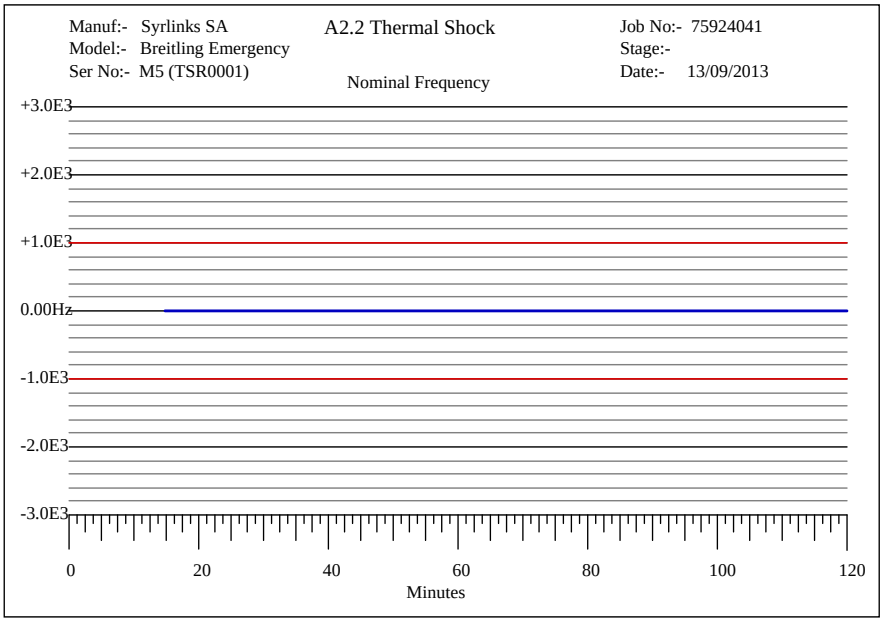
The major items of test equipment used for the above tests are identified in Section 3.1.

2.6.5 Environmental Conditions

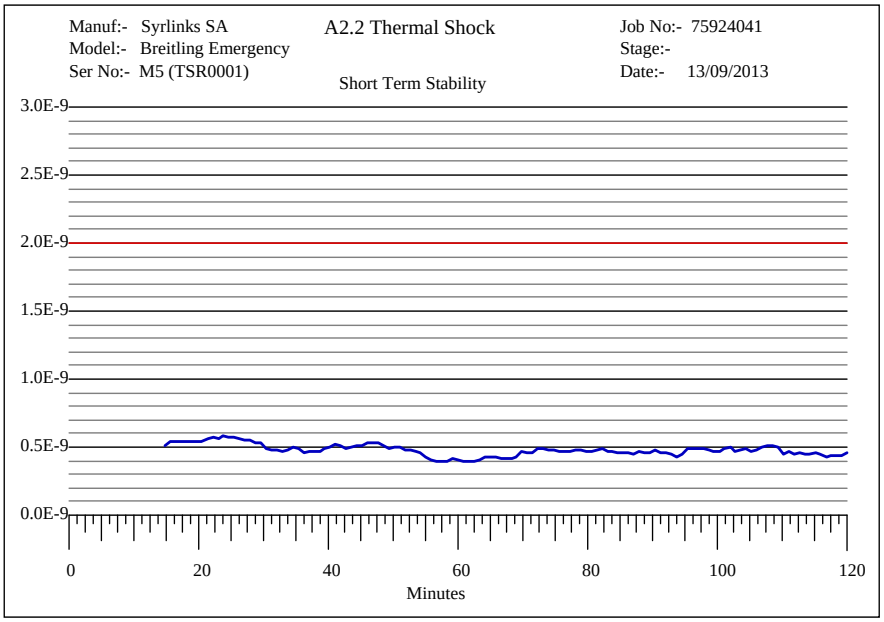
Ambient Temperature 22.5 °C
Relative Humidity 54.5 %

2.6.6 Test Results

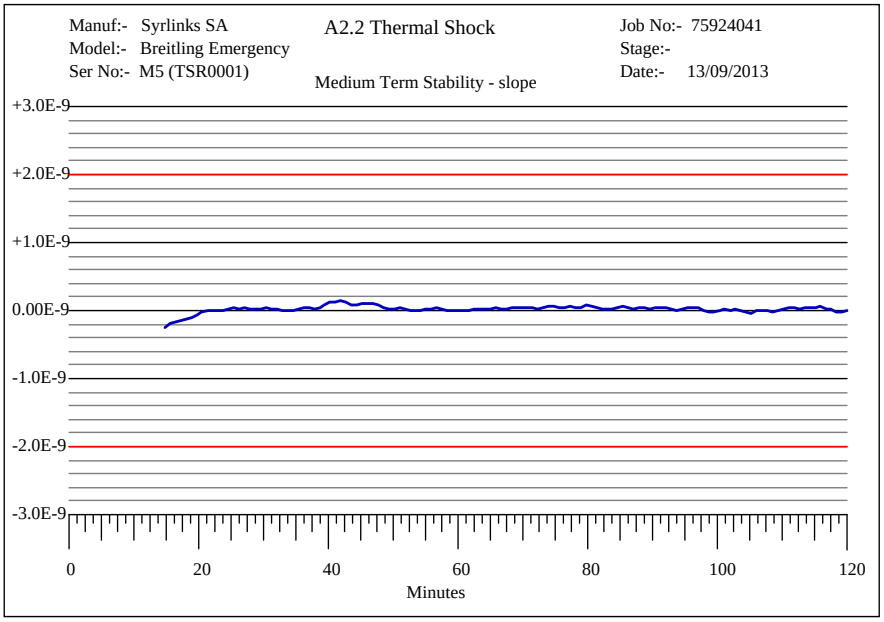
Nominal Frequency



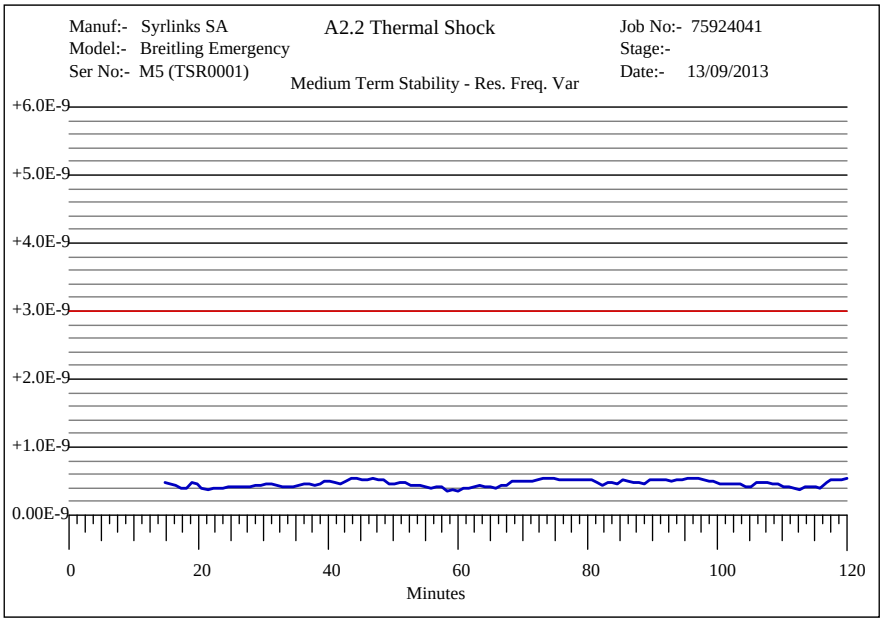
Short Term Stability



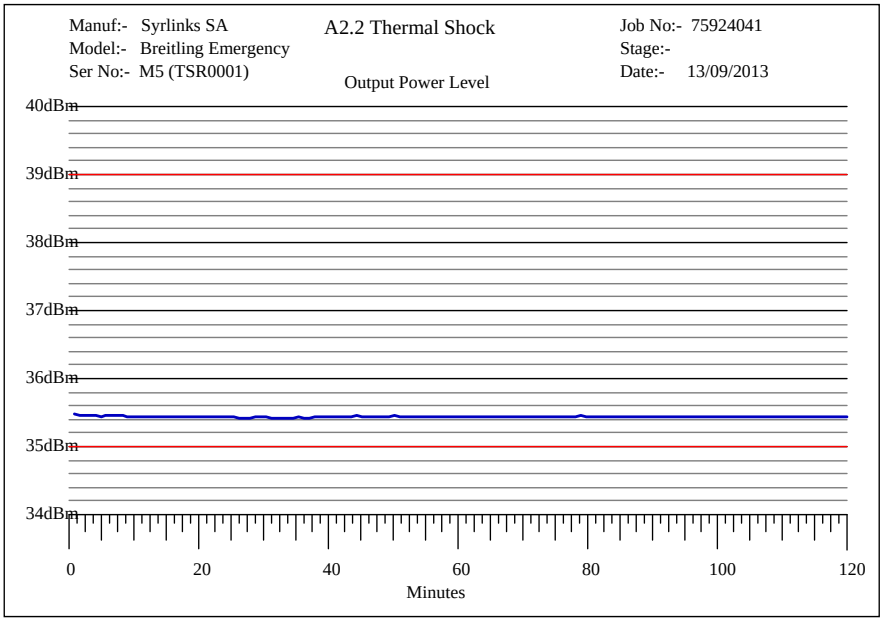
Medium Term Stability, Mean Slope



Medium Term Stability, Residual Frequency Variation



Output Power



Digital Message

```
 Beacon Id Format......... 22 Hex Id, Short Message, Bits 25-112
 15 Hex (Bits 26- 85) = AA4F0E1A4000001              AA4F0E1A4000001 Default_Id
 30 Hex (Bits 25-144) = 5527870D2000000BB31B8000000000

   26   30   34   38   42   46   50   54   58   62   66   70   74   78   82
   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
 0 1010 1010 0100 1111 0000 1110 0001 1010 0100 0000 0000 0000 0000 0000 0001
   0111 0110 0110 0011 0111 0000 0000 0000 0000 0000 0000 0000 0000 0000 000
   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
   86   90   94   98  102  106  110  114  118  122  126  130  134  138  142
```

Field Name	Bit Pos	Value	Decode	Bits
Format Flag	25	0	Short Message	0
Protocol Flag	26	1	User	1
MID	27- 36	338	HAWAII	0101 0100 10
User Protocol	37- 39	3	Serialized	011
Beacon type	40- 42	6	Personal/ PLB	110
Certification type	43	0	National	0
Serial Number	44- 63	231056		0011 1000 0110 1001 0000
National Use	64- 83	0		0000 0000 0000 0000 0000
Manufacturer	44- 51	56	Unknown	NON-SPEC 0011 1000
Sequence Number	52- 63	1680		0110 1001 0000
Model	64- 67	0		0000
Production Run	68- 75	0		0000 0000
U.S. Spare	76- 83	0	Hex=00	0000 0000
Homing	84- 85	1	121.5	01
BCH Encoded	86-106		Errors=0	0111 0110 0110 0011 0111 0
BCH Generated	86-106			0111 0110 0110 0011 0111 0
Emergency Cd Flag	107	0	National Use	0
Beacon Activation	108	0	Manual only	0
National Use	109-112			0000

2.7 OPERATING LIFETIME AT MINIMUM TEMPERATURE

2.7.1 Specification

Cospas-Sarsat T.007, Clause A.2.3

2.7.2 Equipment Under Test and Modification State

Emergency, S/N: M5 - Modification State 2 (Operating Lifetime Measurements)
Emergency, S/N: M6 - Modification State 1 (Current Measurements)

2.7.3 Date of Test

05 & 17 September 2013

2.7.4 Test Equipment Used

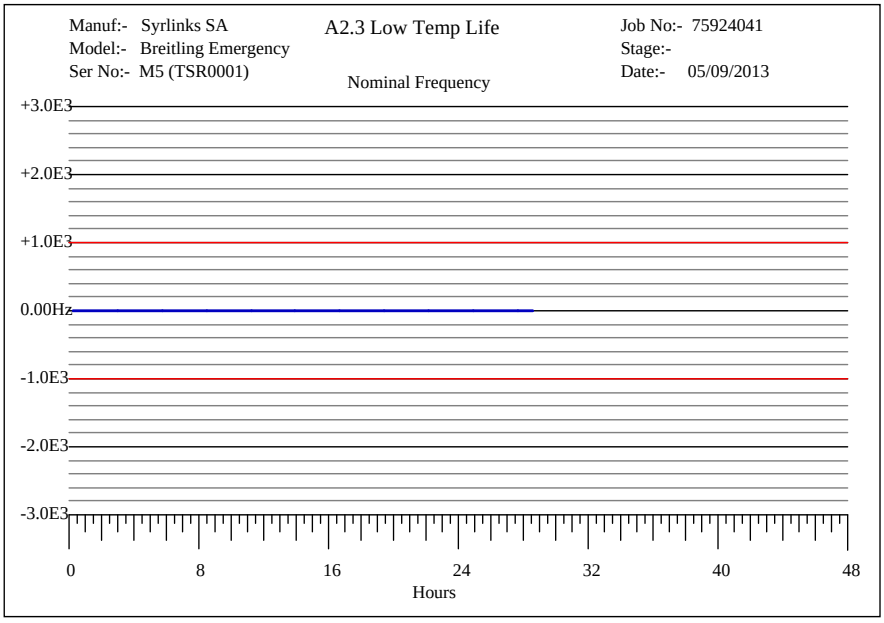
The major items of test equipment used for the above tests are identified in Section 3.1.

2.7.5 Environmental Conditions

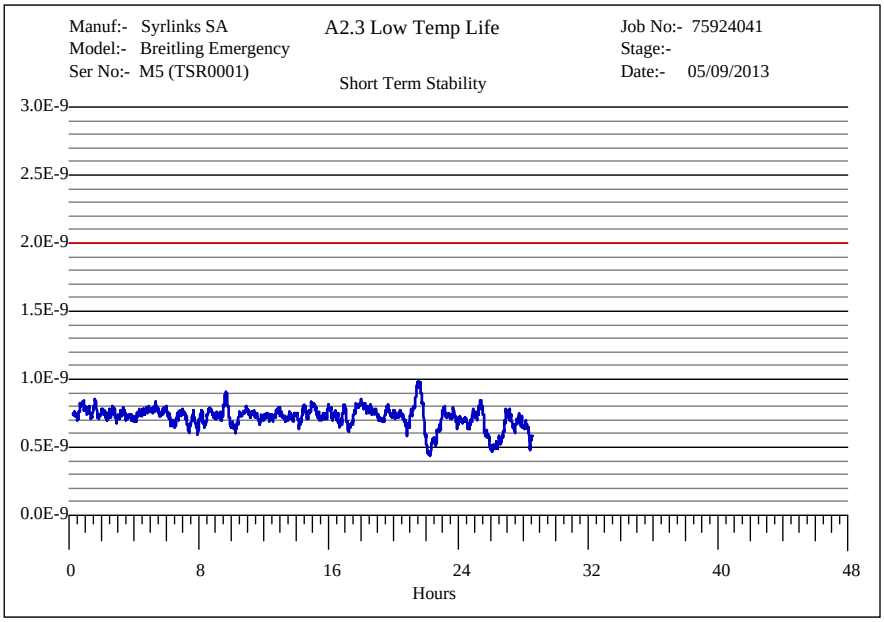
Ambient Temperature 21.6 °C - 21.7 °C
Relative Humidity 61.8 % - 65.5 %

2.7.6 Test Results

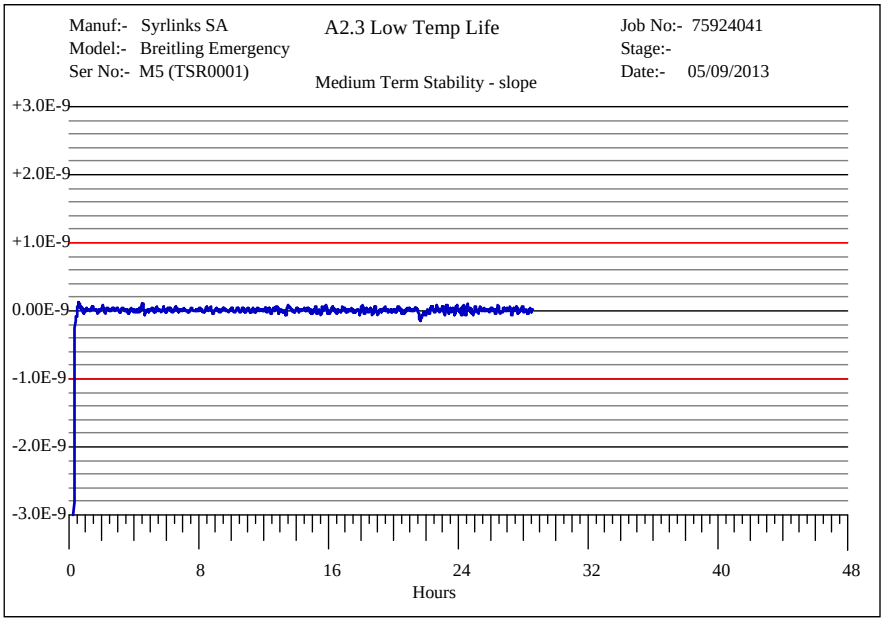
Nominal Frequency



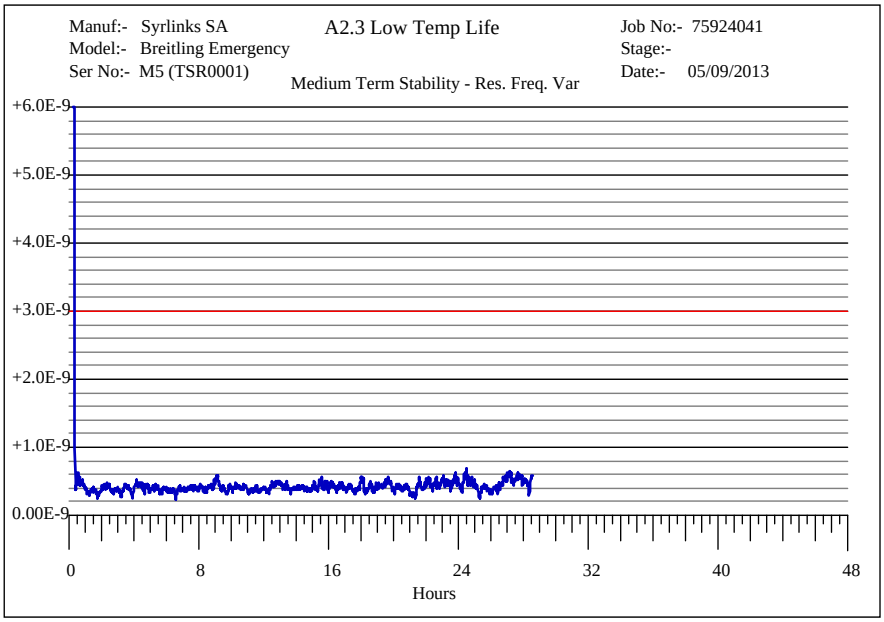
Short Term Stability



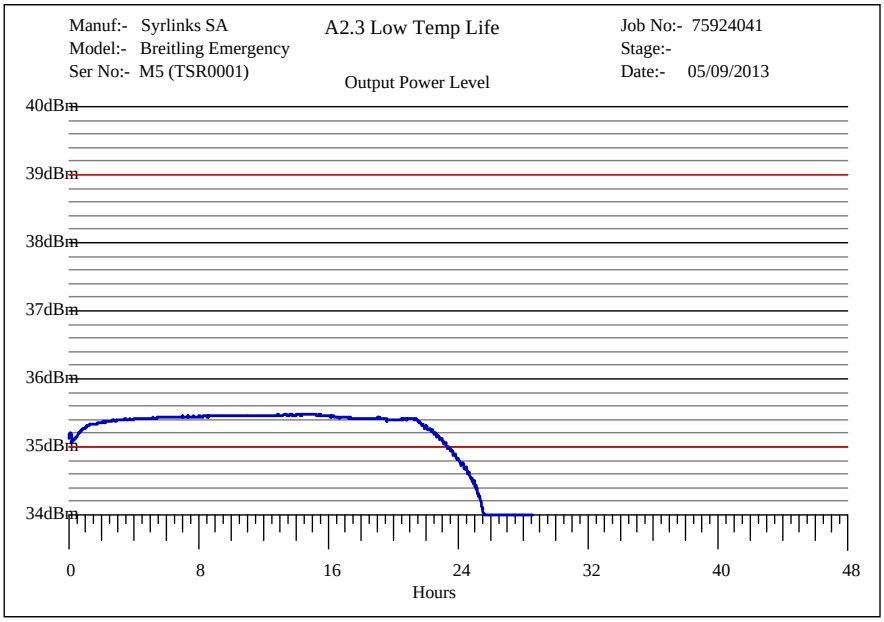
Medium Term Stability, Mean Slope



Medium Term Stability, Residual Frequency Variation



Output Power



Product Service

Digital Message

```
 Beacon Id Format......... 22 Hex Id, Short Message, Bits 25-112
 15 Hex (Bits 26- 85) = AA4F0E1A4000001              AA4F0E1A4000001 Default_Id
 30 Hex (Bits 25-144) = 5527870D2000000BB31B8000000000

   26   30   34   38   42   46   50   54   58   62   66   70   74   78   82
   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
 0 1010 1010 0100 1111 0000 1110 0001 1010 0100 0000 0000 0000 0000 0000 0001
   0111 0110 0110 0011 0111 0000 0000 0000 0000 0000 0000 0000 0000 0000 000
   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
   86   90   94   98  102  106  110  114  118  122  126  130  134  138  142

Field Name        Bit Pos    Value Decode                                 Bits
----------        -------    ----- ------                                 ----
Format Flag        25            0 Short Message                             0
Protocol Flag      26            1 User                                      1
MID                27- 36      338 HAWAII                          0101 0100 10
User Protocol      37- 39        3 Serialized                            011
Beacon type        40- 42        6 Personal/ PLB                         110
Certification type 43            0 National                                0
Serial Number      44- 63   231056                      0011 1000 0110 1001 0000
National Use       64- 83        0                      0000 0000 0000 0000 0000
Manufacturer       44- 51       56 Unknown         NON-SPEC            0011 1000
Sequence Number    52- 63     1680                              0110 1001 0000
Model              64- 67        0                                      0000
Production Run     68- 75        0                                 0000 0000
U.S. Spare         76- 83        0 Hex=00                          0000 0000
Homing             84- 85        1 121.5                                 01
BCH Encoded        86-106          Errors=0           0111 0110 0110 0011 0111 0
BCH Generated      86-106                             0111 0110 0110 0011 0111 0
Emergency Cd Flag 107            0 National Use                            0
Beacon Activation 108            0 Manual only                             0
National Use      109-112                                                0000
```

Test Data (0 min - 30 min)

Burst No.	Nom Freq	STS	MTS-Slope	MTS Res	Power	Time (h)
1	-	-	-	-	35.132	0.013945
2	-	-	-	-	35.189	0.027274
3	-	-	-	-	35.196	0.040616
4	-	-	-	-	35.199	0.053919
5	-	-	-	-	35.203	0.068377
6	-	-	-	-	35.204	0.081992
7	-	-	-	-	35.209	0.096168
8	-	-	-	-	35.179	0.109505
9	-	-	-	-	35.18	0.122839
10	-	-	-	-	35.18	0.136146
11	-	-	-	-	35.187	0.150608
12	-	-	-	-	35.057	0.164214
13	-	-	-	-	35.071	0.178394
14	-	-	-	-	35.074	0.191732
15	-	-	-	-	35.081	0.205061
16	-	-	-	-	35.077	0.218364
17	-	-	-	-	35.083	0.232821
18	406040009.2	7.43E-10	-6.22E-09	1.16E-08	35.091	0.246437
19	406040007.4	7.47E-10	-5.49E-09	1.23E-08	35.093	0.260616
20	406040005.7	7.55E-10	-4.62E-09	1.23E-08	35.1	0.273945
21	406040004.1	7.52E-10	-3.71E-09	1.15E-08	35.101	0.287288
22	406040002.7	7.34E-10	-2.80E-09	9.94E-09	35.107	0.300586
23	406040001.6	7.52E-10	-1.94E-09	7.97E-09	35.115	0.315052
24	406040000.6	7.51E-10	-1.22E-09	5.57E-09	35.117	0.328654
25	406040000	7.58E-10	-6.83E-10	3.19E-09	35.124	0.342839
26	406039999.6	7.52E-10	-3.71E-10	1.57E-09	35.127	0.356168
27	406039999.3	7.59E-10	-2.40E-10	9.75E-10	35.129	0.36951
28	406039999.2	7.55E-10	-1.52E-10	5.19E-10	35.133	0.382808
29	406039999.1	7.47E-10	-1.20E-10	3.81E-10	35.137	0.397266
30	406039999.1	7.52E-10	-9.94E-11	3.81E-10	35.141	0.410877
31	406039999	7.32E-10	-1.03E-10	3.89E-10	35.137	0.425065
32	406039999	7.41E-10	-1.11E-10	3.78E-10	35.137	0.438399
33	406039999	7.37E-10	-8.82E-11	4.40E-10	35.136	0.451732
34	406039998.9	7.26E-10	-7.30E-11	4.55E-10	35.141	0.465031
35	406039998.9	7.09E-10	-5.24E-11	5.09E-10	35.151	0.479488
36	406039998.9	7.08E-10	-6.64E-12	5.42E-10	35.155	0.493095
37	406039998.9	7.01E-10	3.05E-12	5.45E-10	35.162	0.507283

Current Measurement Results

Beacon Operating Modes	Mode: Manually selectable or Automatic	Measurement interval, sec	Average Current, mA	Peak Current, mA
ON at EUT switch (Ambient Temperature)	M	900	25.79	2027.78
ON at EUT switch (-5 °C)	M	900	22.00	1757.41
ON at EUT switch (-20 °C)	M	900	21.48	1635.74
Standby (Ambient Temperature)[note 1]	A	1800	0.0089	0.00906
Standby (-20°C) [note 1]	A	1800	0.0085	0.00861
Self-test	A	2.400	442.63	2290.26

Note 1: In all cases, the measurement sampling rate was 80 ms.

The manufacturer has advised that the worst case battery drain should be considered as:

- The user recharges the battery at every TBRC (2 months) over a 2 year period
- The EUT is activated at the battery replacement date
- For this reason, only ONE self-test should be included in the discharge calculation (User removes EUT from Charger upon successful Self Tests after the Final Battery recharge (TBRC x 12))

Further analysis of the battery is shown in the table below. A battery data sheet can be found with the manufacturer supplied data in Annex A:

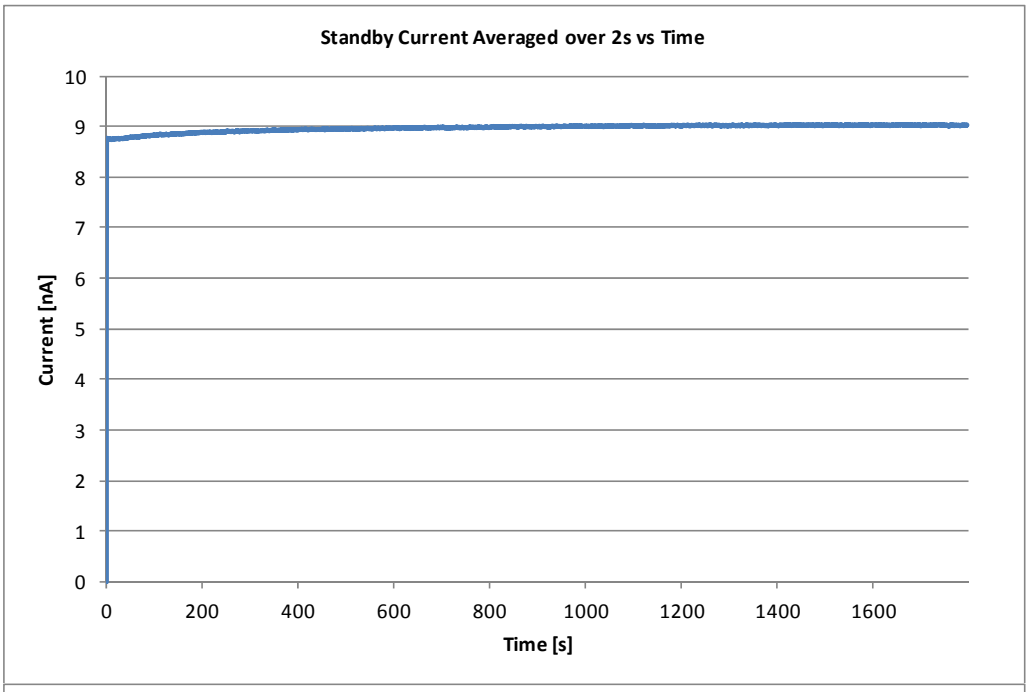
Time Between Recommended Charges (TBRC) = 2 months			
Initial battery capacity = 1150mAh			
	Losses (%)	Losses (mAh)	Calculation
Reversible losses of the battery capacity over TBRC	1.11%	12.765	(1150 x 0.0111)
Irreversible losses of battery capacity with max.2 years storage	7.00%	80.5	(1150 x 0.07)
Irreversible losses of battery capacity in standby mode	7.00%	80.5	(1150 x 0.07)
Losses due to current drain resulting from the constant operation of the beacon		12.81	(0.0089 x 24 x 60)
Losses due to current drain resulting from the constant operation of the battery (protection circuit)		17	Manufacturer supplied data
Number of self test=1 (just after the last charge)		0.29	0.5 x 2 x 442.63x10-3 x (2.4/3600)
Total Losses + 1.65 co-efficient		336.38	Sum of the above losses x 1.65
Residual capacity after discharge (mAh)		813.62	Battery capacity - Total Losses
Discharge the battery required (mAh)	336.38		
Predischarge current (mA)	200		
Time of predischarge (h)	1.68		
Colour Code:			
Loss calculated from battery data sheet			
Loss calculated from measurement data			
Loss supplied by manufacturer			

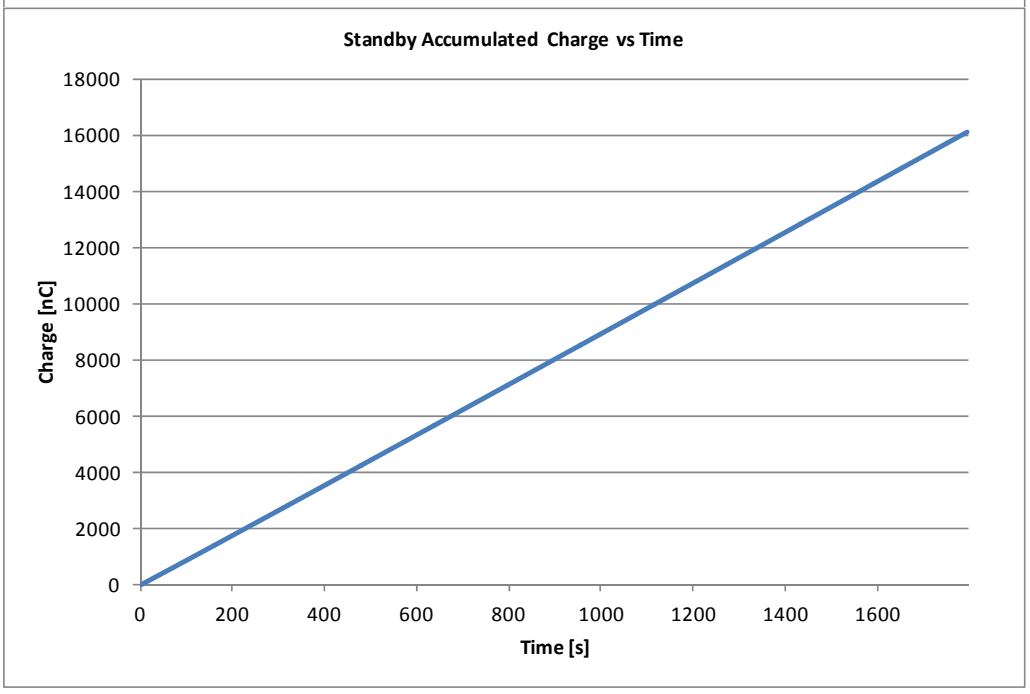
Data supplied by manufacturer: 12 µA from battery datasheet

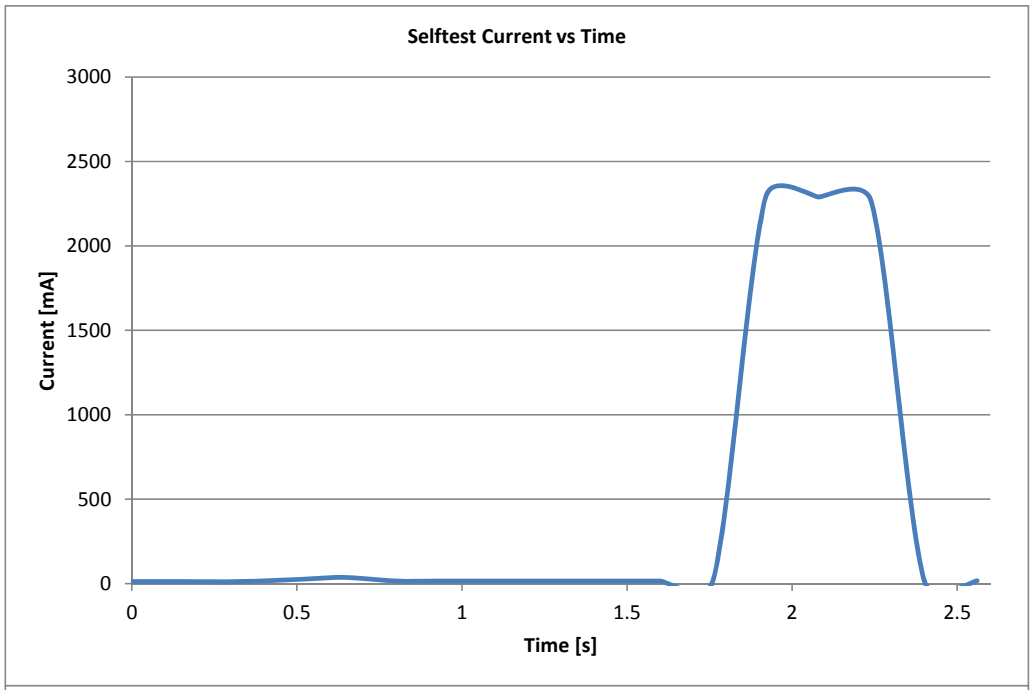
The preferred method of battery discharge was a constant current method, using a programmable electronic load (supplied by the manufacturer) – therefore the actual discharge time of 1.68 hours is reported in the summary table at the beginning of this report.

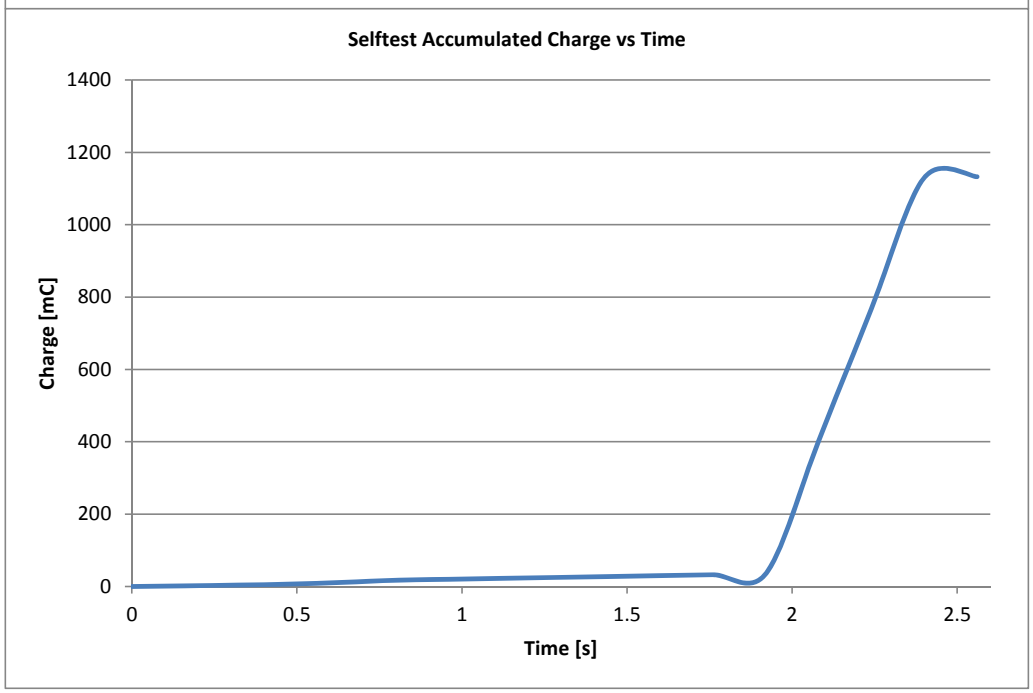
Current Plots

Ambient Temperature

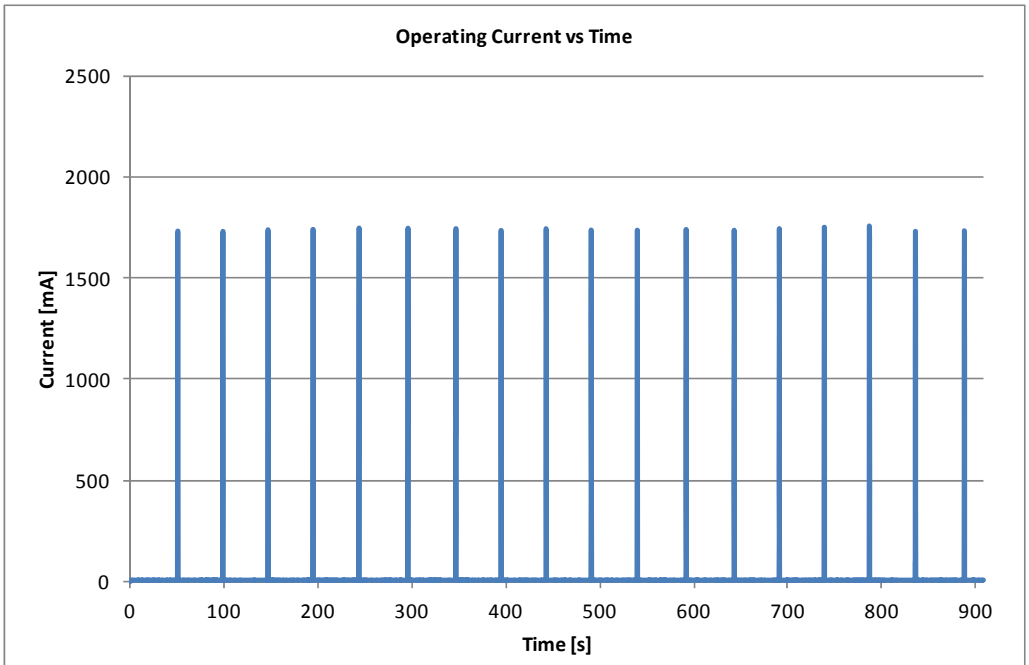


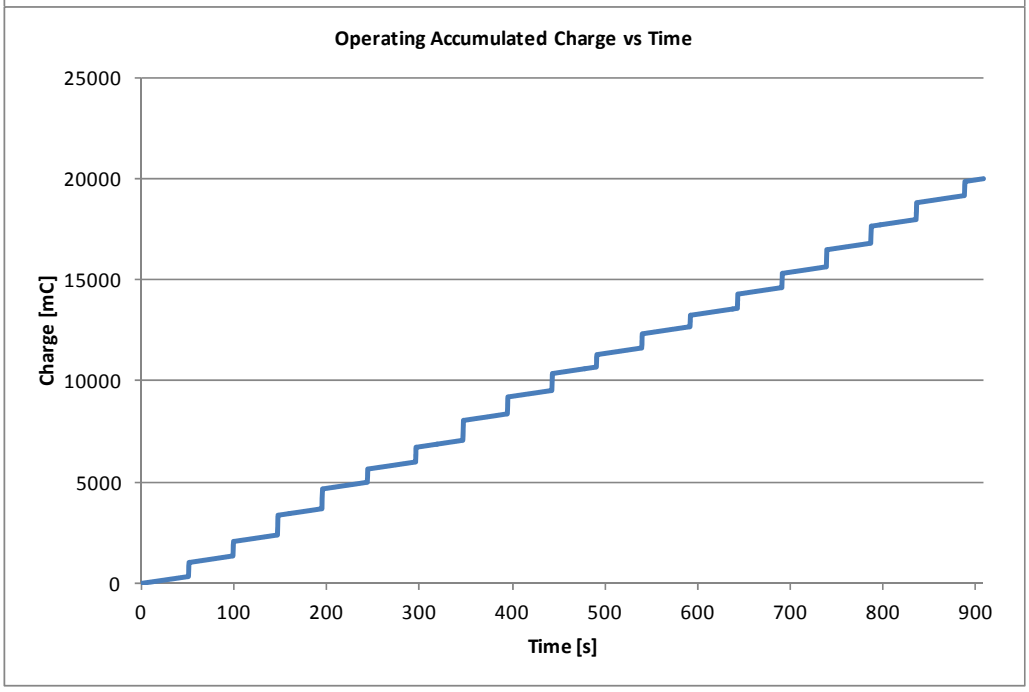



Selftest Current vs Time
Current [mA]
3000
2500
2000
1500
1000
500
0
0
0.5
1
1.5
2
2.5
Time [s]

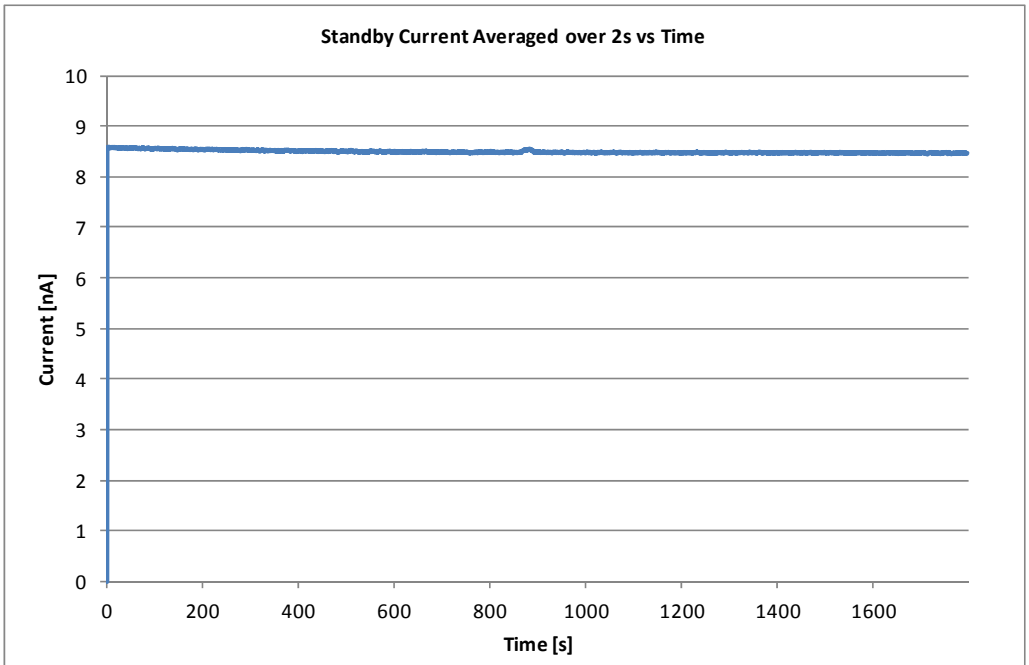

Selftest Accumulated Charge vs Time
Charge [mC]
1400
1200
1000
800
600
400
200
0
0
0.5
1
1.5
2
2.5
Time [s]

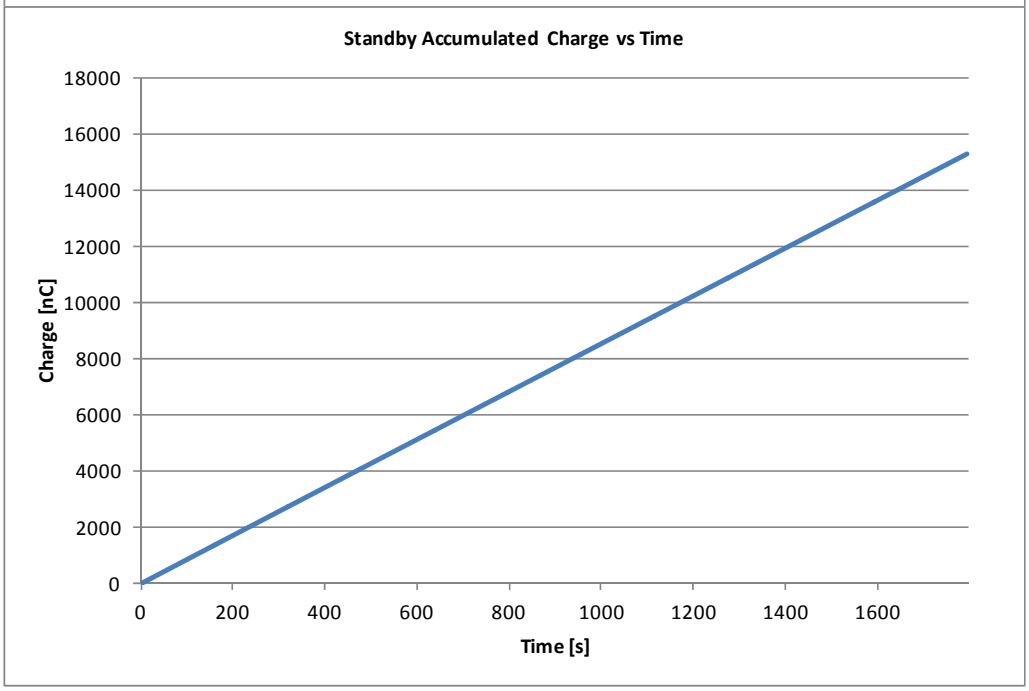
Additional Current Measurements @ -5 °C

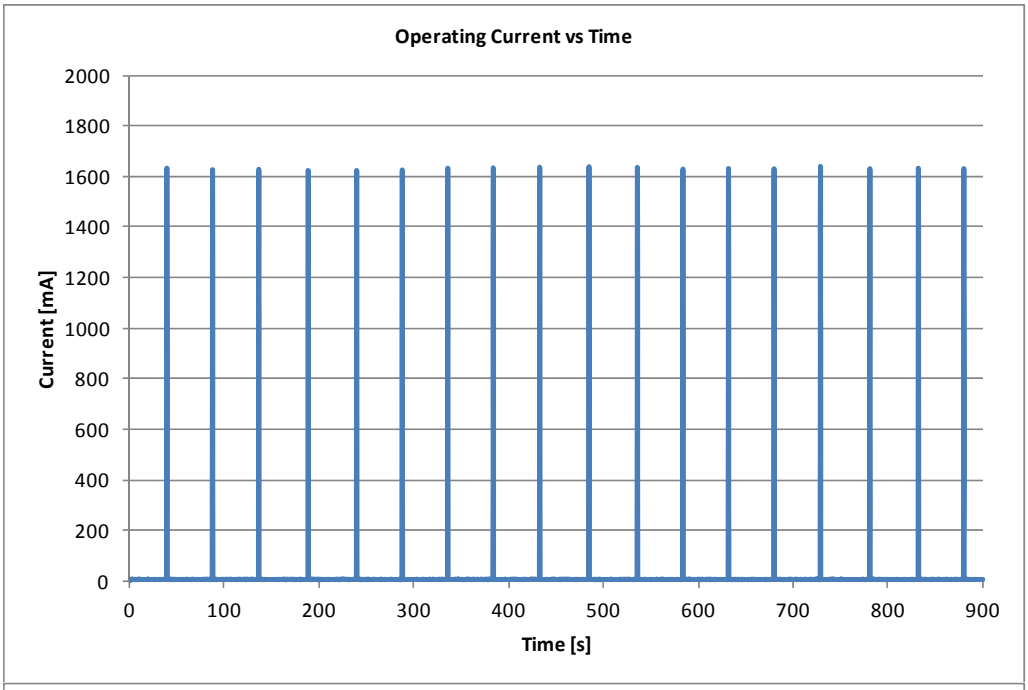


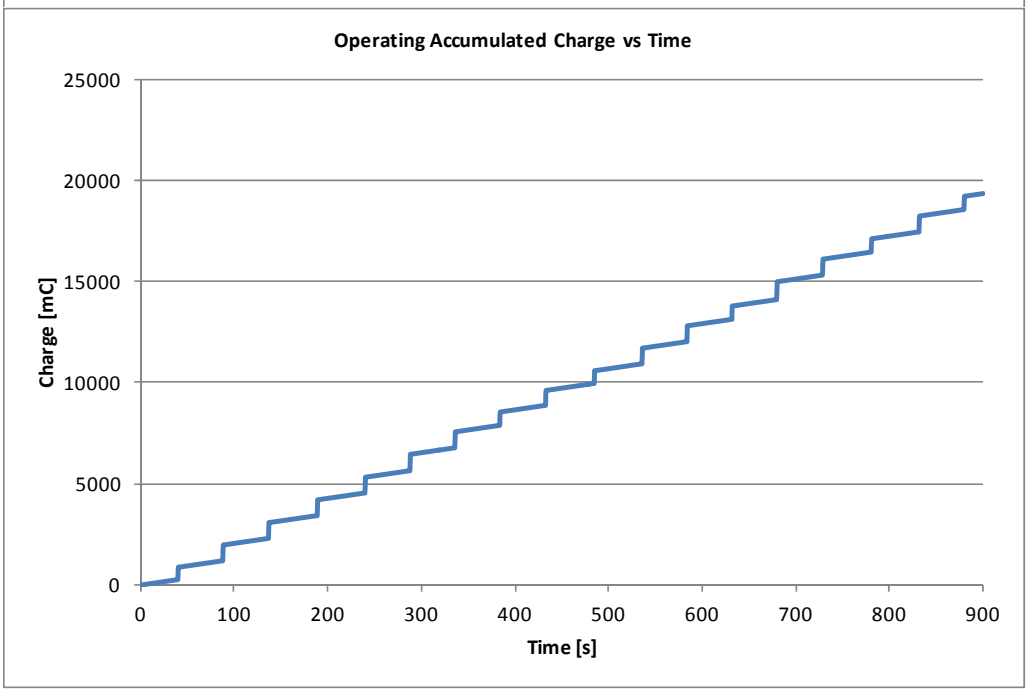


Additional Current Measurements @ -20 °C






Operating Current vs Time
Current [mA]
2000
1800
1600
1400
1200
1000
800
600
400
200
0
0
100
200
300
400
500
600
700
800
900
Time [s]


Operating Accumulated Charge vs Time
Charge [mC]
25000
20000
15000
10000
5000
0
0
100
200
300
400
500
600
700
800
900
Time [s]

2.8 OPERATING LIFETIME AT 0 °C (ADDITIONAL TESTING)

2.8.1 Specification

Cospas-Sarsat T.007, Clause A.2.3

2.8.2 Equipment Under Test and Modification State

Emergency, S/N: M5 - Modification State 2

2.8.3 Date of Test

06, 08 & 09 September 2013

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

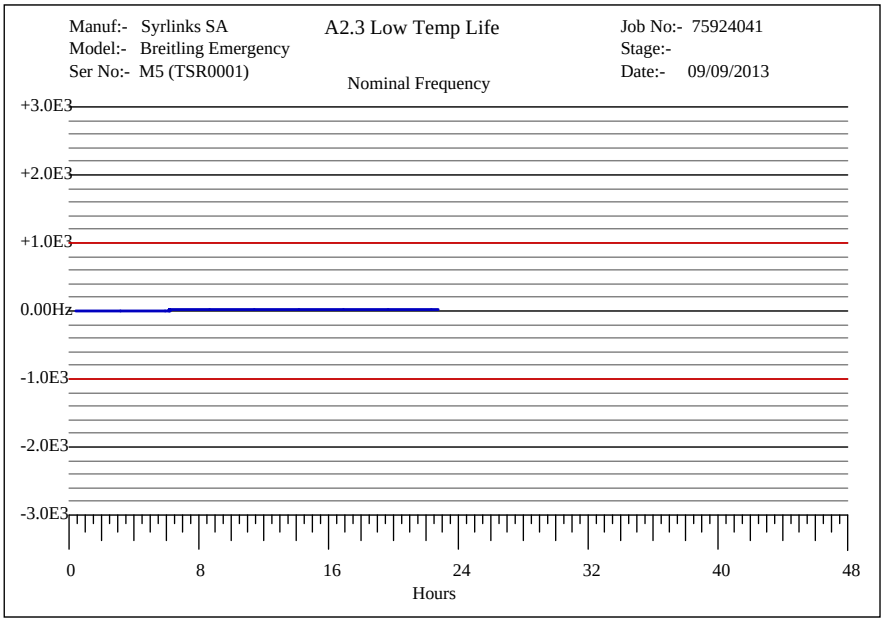
Ambient Temperature 21.1 °C - 22.1 °C
Relative Humidity 44.5 % - 52.0 %

2.8.6 Test Results

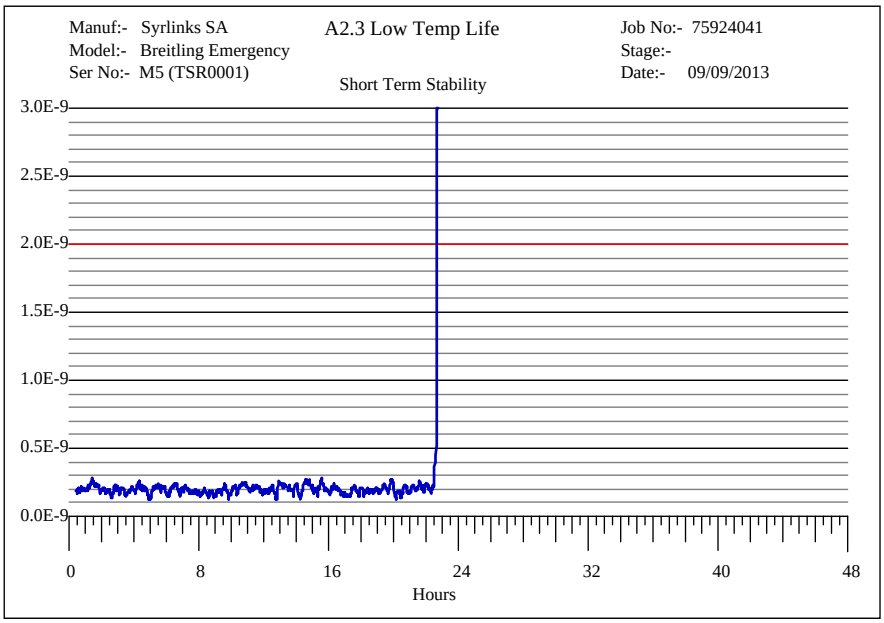
This test was conducted at the request of the Cospas-Sarsat Secretariat. For the previous test in section 2.7, the EUT homing transmitter was inactive, due to the test temperature being below the operating threshold of the homing device. This test has been performed at 0 °C, just above the homing device deactivation threshold of -1 °C.

The battery current discharge figure for this test has been taken from the measurements and calculation in section 2.7 of this report.

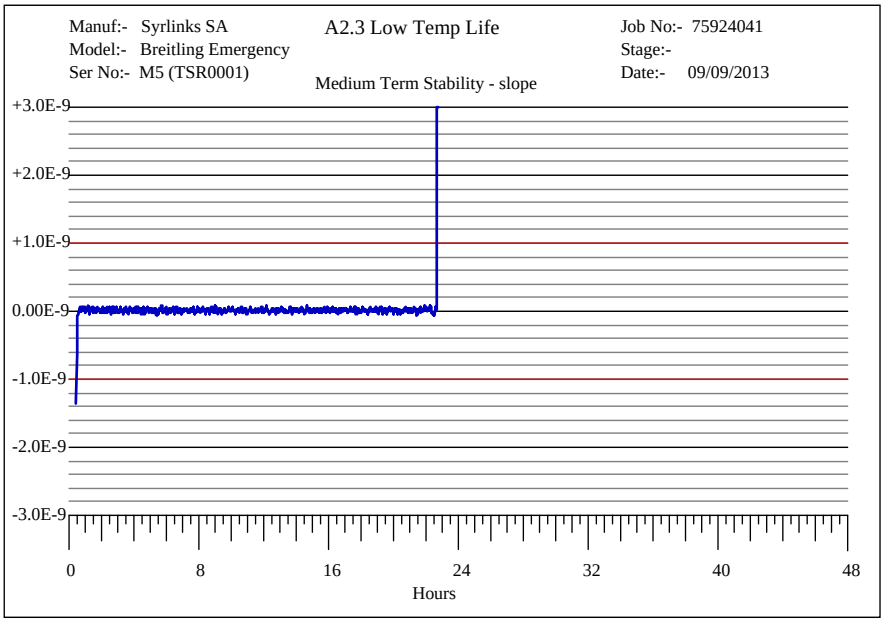
Nominal Frequency



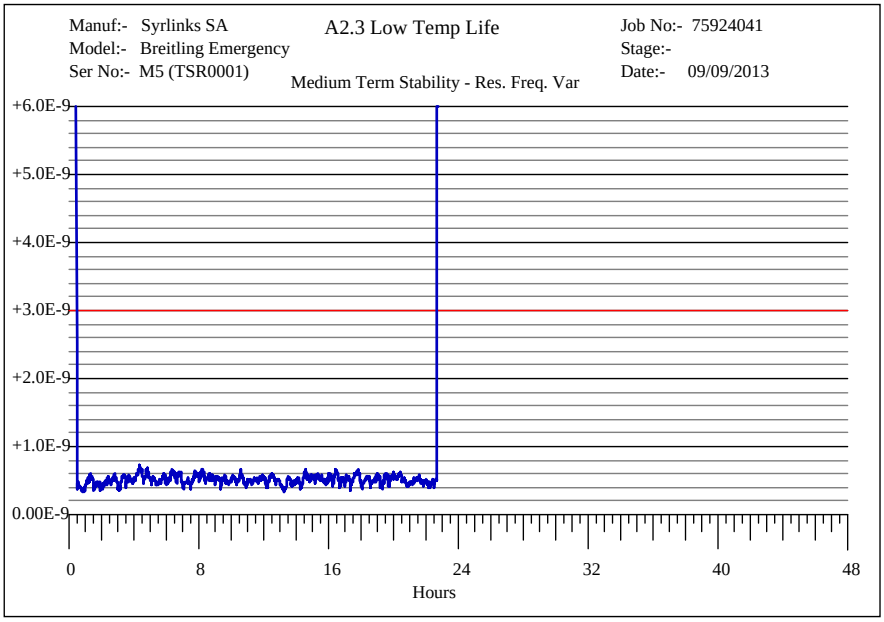
Short Term Stability



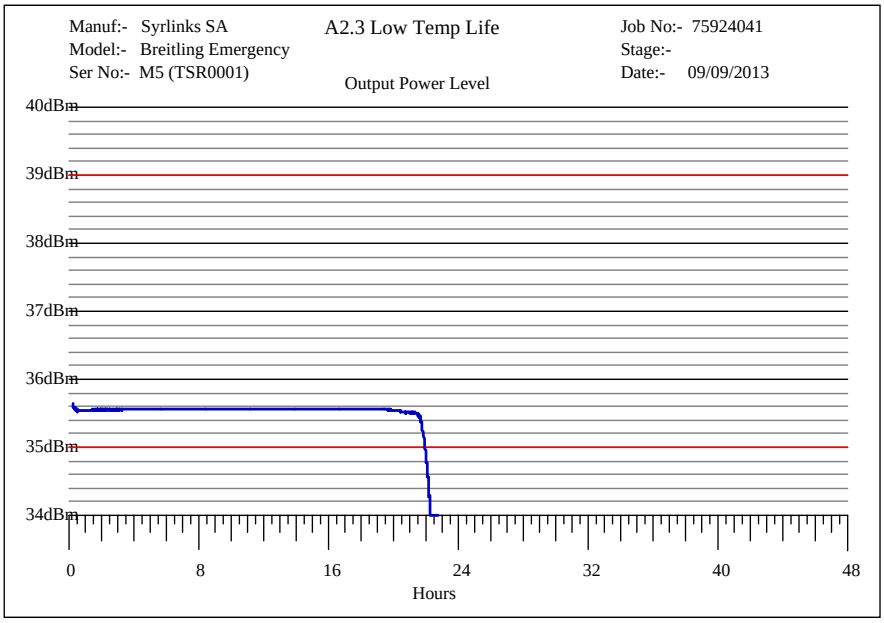
Medium Term Stability, Mean Slope



Medium Term Stability, Residual Frequency Variation



Output Power



Digital Message

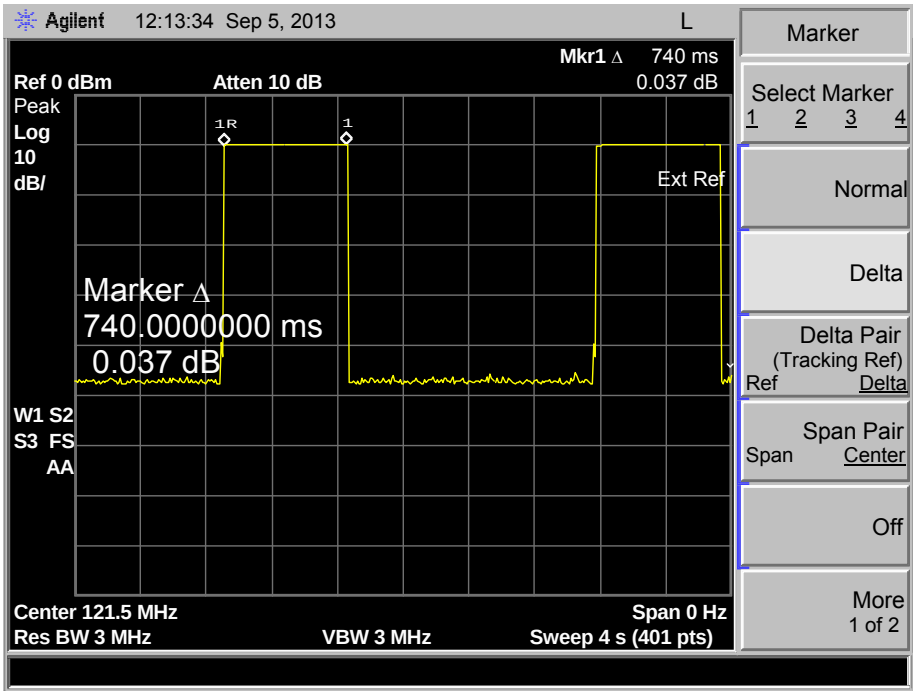
```
Beacon Id Format..... 22 Hex Id, Short Message, Bits 25-112
 15 Hex (Bits 26- 85) = AA4F0E1A4000001              AA4F0E1A4000001 Default_Id
 30 Hex (Bits 25-144) = 5527870D2000000BB31B8000000000

   26   30   34   38   42   46   50   54   58   62   66   70   74   78   82
   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
 0 1010 1010 0100 1111 0000 1110 0001 1010 0100 0000 0000 0000 0000 0000 0001
   0111 0110 0110 0011 0111 0000 0000 0000 0000 0000 0000 0000 0000 0000 000
   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
   86   90   94   98  102  106  110  114  118  122  126  130  134  138  142

Field Name        Bit Pos    Value Decode                                  Bits
----------        -------    ----- ------                                  ----
Format Flag        25            0 Short Message                              0
Protocol Flag      26            1 User                                       1
MID                27- 36      338 HAWAII                          0101 0100 10
User Protocol      37- 39        3 Serialized                                011
Beacon type        40- 42        6 Personal/ PLB                             110
Certification type 43            0 National                                   0
Serial Number      44- 63   231056                      0011 1000 0110 1001 0000
National Use       64- 83        0                      0000 0000 0000 0000 0000
Manufacturer       44- 51       56 Unknown          NON-SPEC             0011 1000
Sequence Number    52- 63     1680                               0110 1001 0000
Model              64- 67        0                                        0000
Production Run     68- 75        0                                   0000 0000
U.S. Spare         76- 83        0 Hex=00                            0000 0000
Homing             84- 85        1 121.5                                    01
BCH Encoded        86-106          Errors=0           0111 0110 0110 0011 0111 0
BCH Generated      86-106                             0111 0110 0110 0011 0111 0
Emergency Cd Flag 107            0 National Use                               0
Beacon Activation 108            0 Manual only                                0
National Use      109-112                                                0000
```

Test Data (0 min - 30 min)

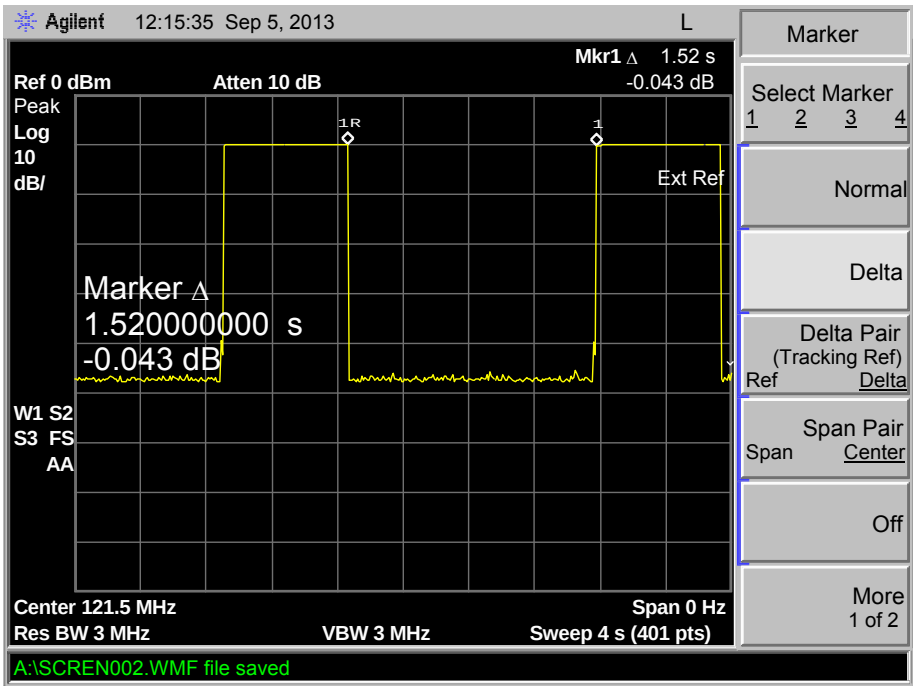
Burst No.	Nom Freq	STS	MTS-Slope	MTS-Res	Power	Time (Hrs)
1	-	-	-	-	35.64	0.012274
2	-	-	-	-	35.618	0.025608
3	-	-	-	-	35.625	0.038937
4	-	-	-	-	35.606	0.052248
5	-	-	-	-	35.611	0.066706
6	-	-	-	-	35.587	0.080321
7	-	-	-	-	35.59	0.094497
8	-	-	-	-	35.586	0.10783
9	-	-	-	-	35.572	0.121159
10	-	-	-	-	35.585	0.134462
11	-	-	-	-	35.569	0.148915
12	-	-	-	-	35.567	0.162535
13	-	-	-	-	35.574	0.176706
14	-	-	-	-	35.552	0.190043
15	-	-	-	-	35.554	0.203386
16	-	-	-	-	35.556	0.216684
17	-	-	-	-	35.555	0.231163
18	406040009.7	1.92E-10	-1.36E-09	7.09E-09	35.558	0.244757
19	406040008.8	1.92E-10	-6.28E-10	2.53E-09	35.541	0.258924
20	406040008.4	1.95E-10	-3.79E-10	1.04E-09	35.533	0.27227
21	406040008.3	1.95E-10	-2.94E-10	7.66E-10	35.538	0.285599
22	406040008.2	1.83E-10	-2.30E-10	6.07E-10	35.526	0.298906
23	406040008.1	1.64E-10	-1.80E-10	4.91E-10	35.533	0.313359
24	406040008	1.81E-10	-1.21E-10	3.82E-10	35.555	0.326971
25	406040008	1.78E-10	-6.99E-11	4.52E-10	35.539	0.341146
26	406040008	1.78E-10	-4.67E-11	4.85E-10	35.542	0.354484
27	406040008	2.03E-10	-3.26E-11	4.84E-10	35.538	0.367826
28	406040008	2.05E-10	-2.74E-11	4.83E-10	35.541	0.381129
29	406040008	1.94E-10	-2.55E-11	4.82E-10	35.542	0.395586
30	406040008	1.94E-10	7.39E-14	4.43E-10	35.541	0.409197
31	406040007.9	2.00E-10	4.05E-12	4.39E-10	35.548	0.423377
32	406040007.9	1.83E-10	1.00E-11	4.24E-10	35.539	0.436706
33	406040007.9	1.83E-10	1.64E-11	4.11E-10	35.538	0.450039
34	406040007.9	1.73E-10	3.21E-11	3.88E-10	35.538	0.463333
35	406040007.9	1.94E-10	3.10E-11	3.86E-10	35.541	0.477799
36	406040007.9	1.97E-10	6.01E-11	4.10E-10	35.537	0.491411

121 Homing Transmitter - Duty Cycle (Start of Test)

On Time



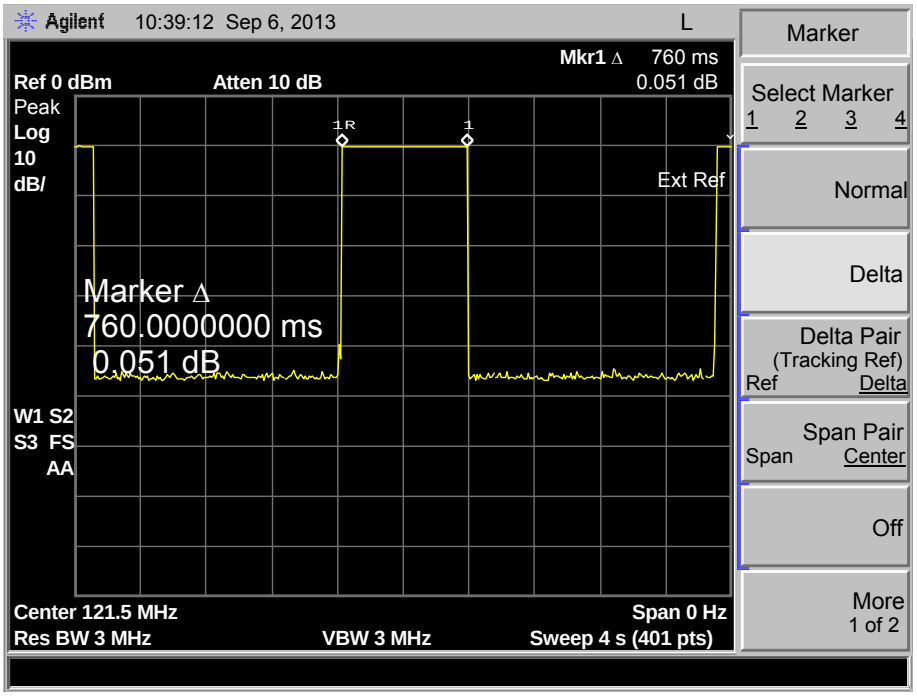
Off Time



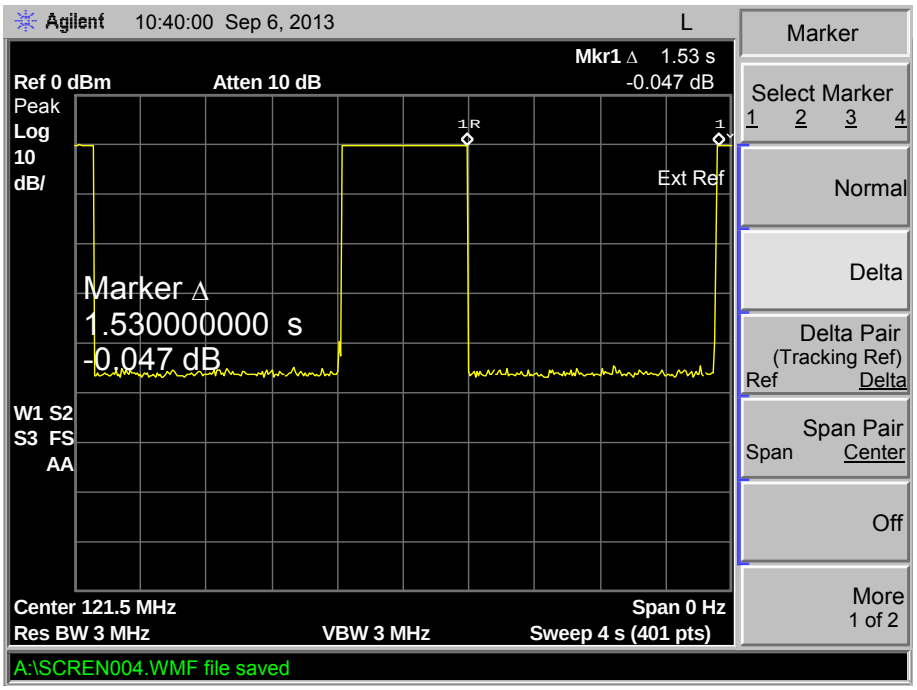
Duty Cycle = 0.74 / (0.74 + 1.52) = 0.327 = 32.7 %

121 Homing Transmitter - Duty Cycle (End of Test)

On Time

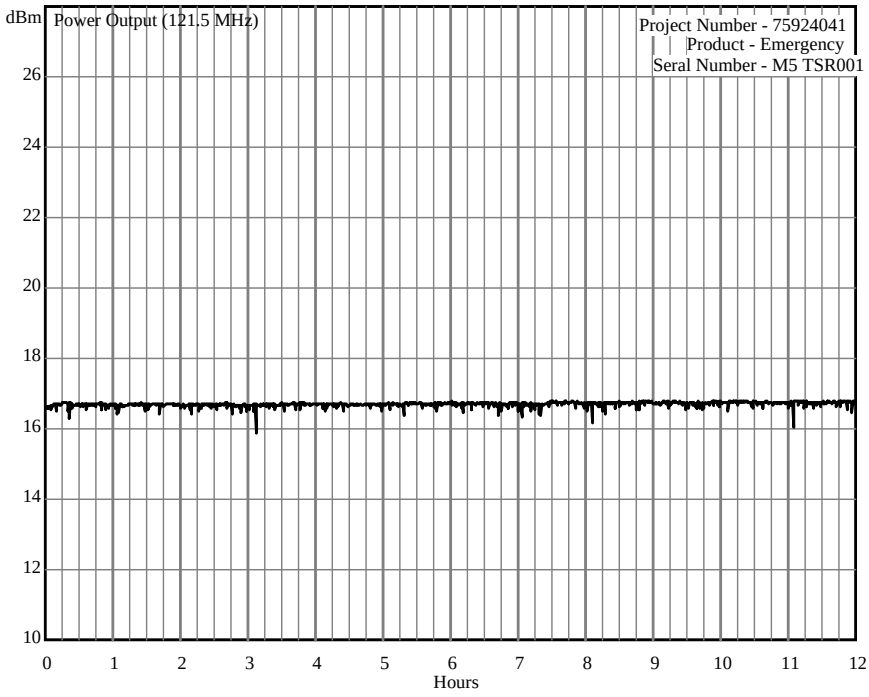


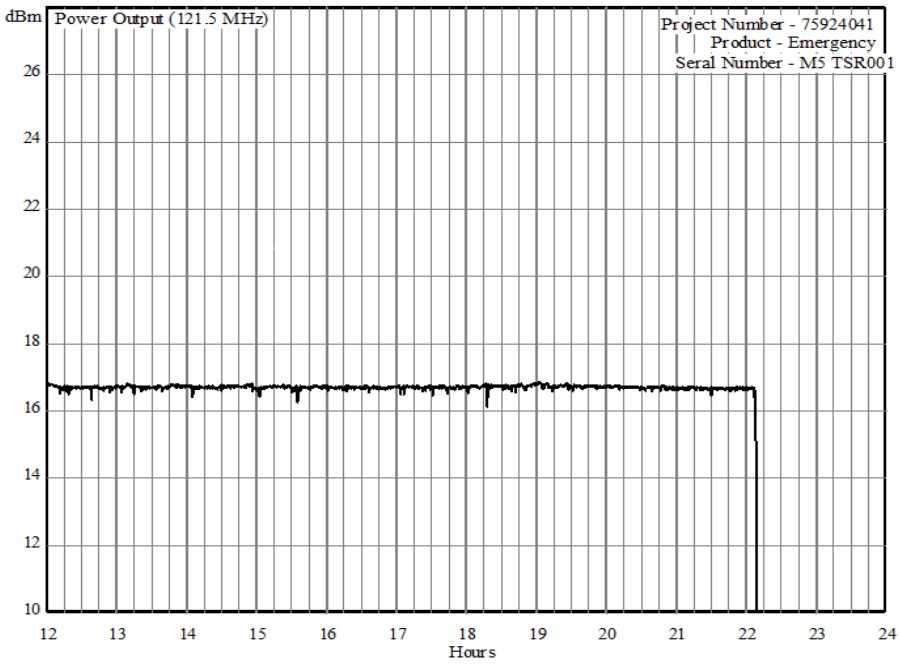
Off Time



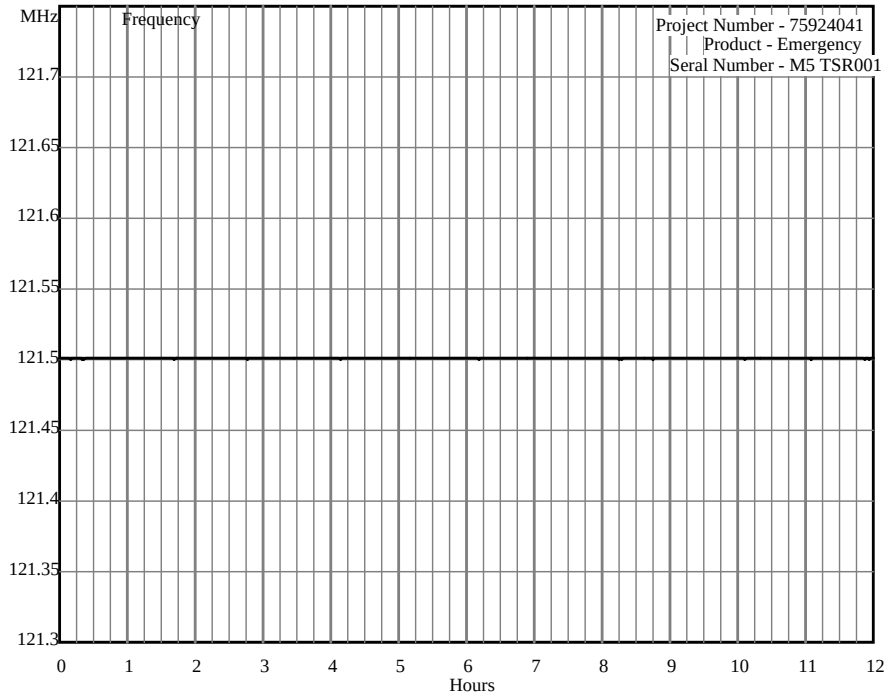
Duty Cycle = 0.76 / (0.76+1.53) = 0.331 = 33.1%

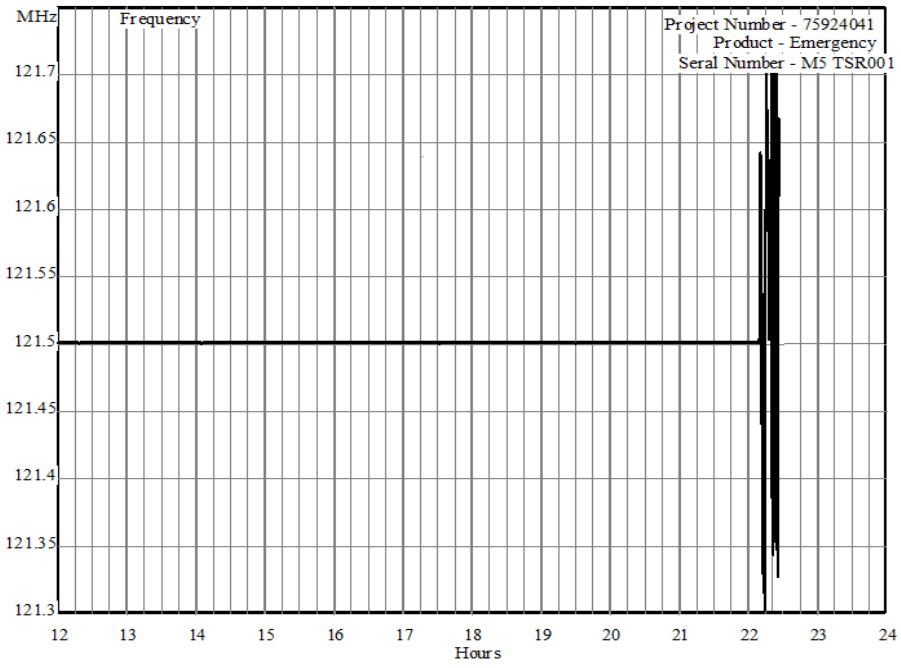
121 Homing Transmitter Power (First 24 Hours of Operation)





121 Homing Transmitter Frequency (First 24 Hours of Operation)





2.9 FREQUENCY STABILITY TEST WITH TEMPERATURE GRADIENT

2.9.1 Specification

Cospas-Sarsat T.007, Clause A.2.4

2.9.2 Equipment Under Test and Modification State

Emergency, S/N: M5 - Modification State 1 (Up ramp only)
Emergency, S/N: M5 - Modification State 2 (Down ramp only)

2.9.3 Date of Test

07 & 10 September 2013

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 22.1 °C
Relative Humidity 47.1 %

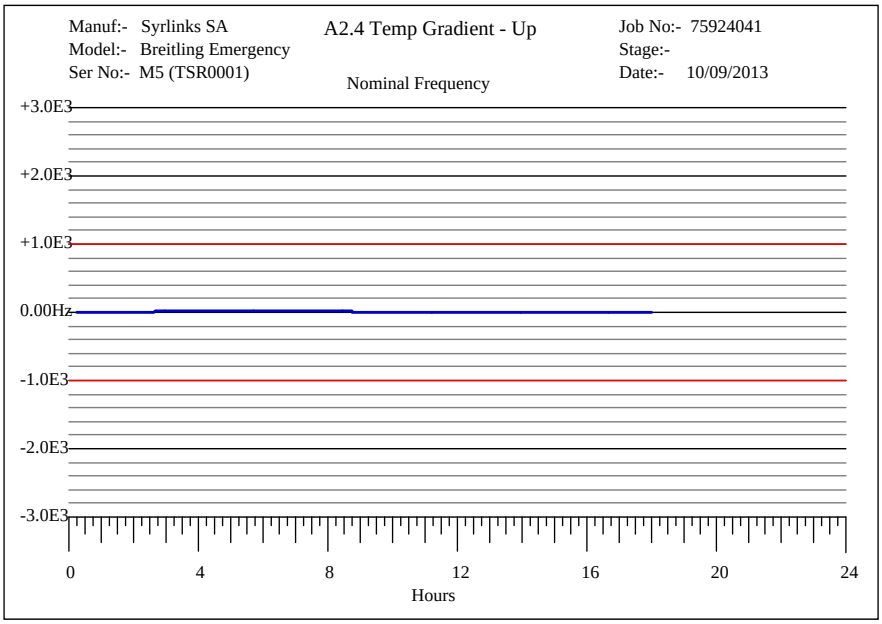
2.9.6 Test Results

Test Sample fitted with TCXO 'E5829 LG 3925'

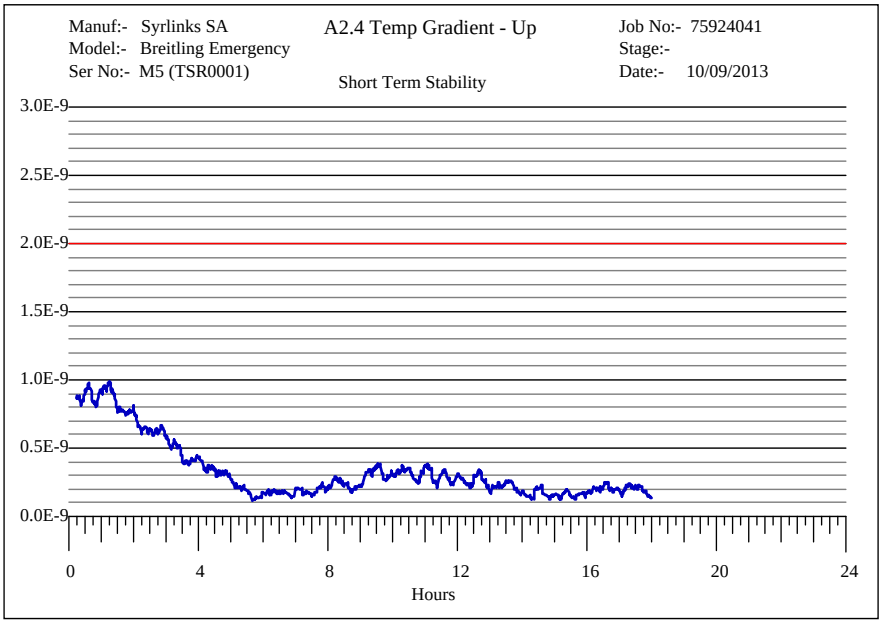
* Modification State 1 used for Up Ramp test. Modification State 1 allows the EUT to be switched on/off via an external switch for ease of testing. Modification State 2 used for Down Ramp test. Modification State 2 allows the EUT to be switched on but not off via an external switch. This was implemented because Mod State 1 was found to draw more current, and the manufacturer had concerns about meeting the test duration of the down ramp.

Up Ramp

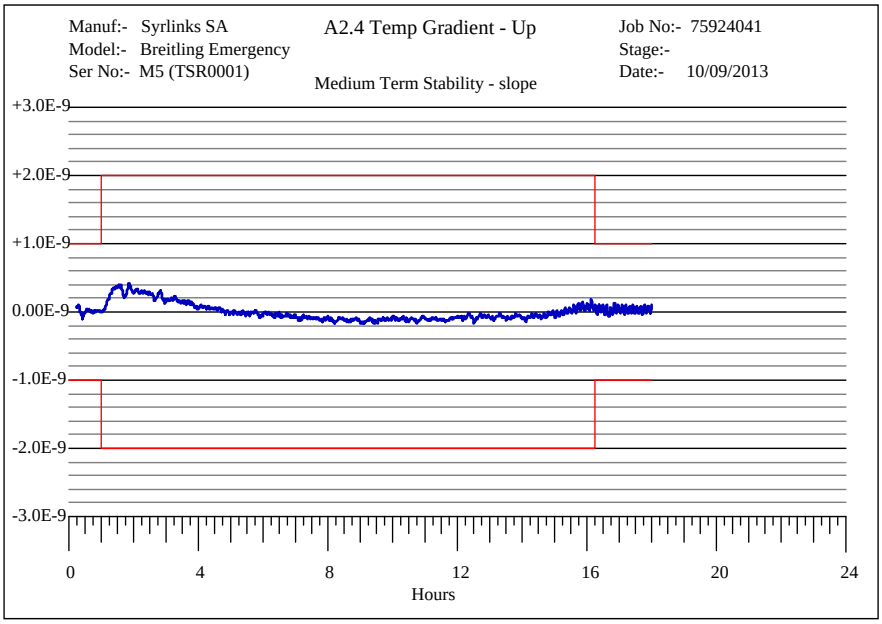
Nominal Frequency



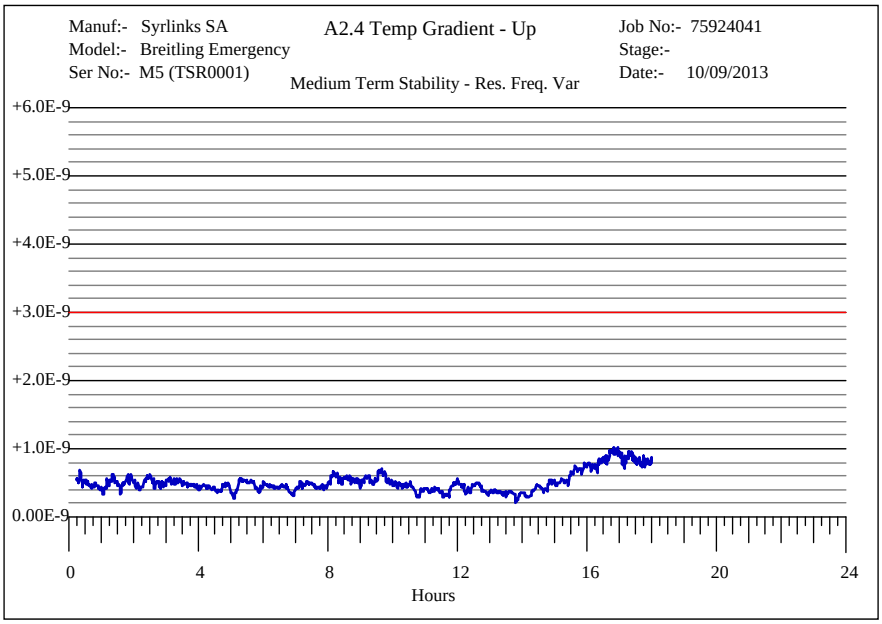
Short Term Stability



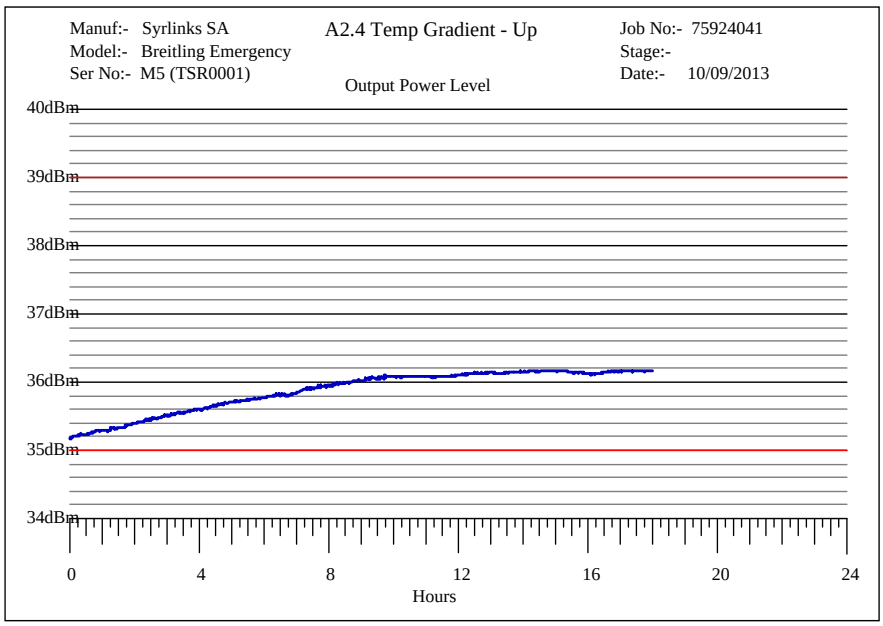
Medium Term Stability, Mean Slope



Medium Term Stability, Residual Frequency Variation



Output Power

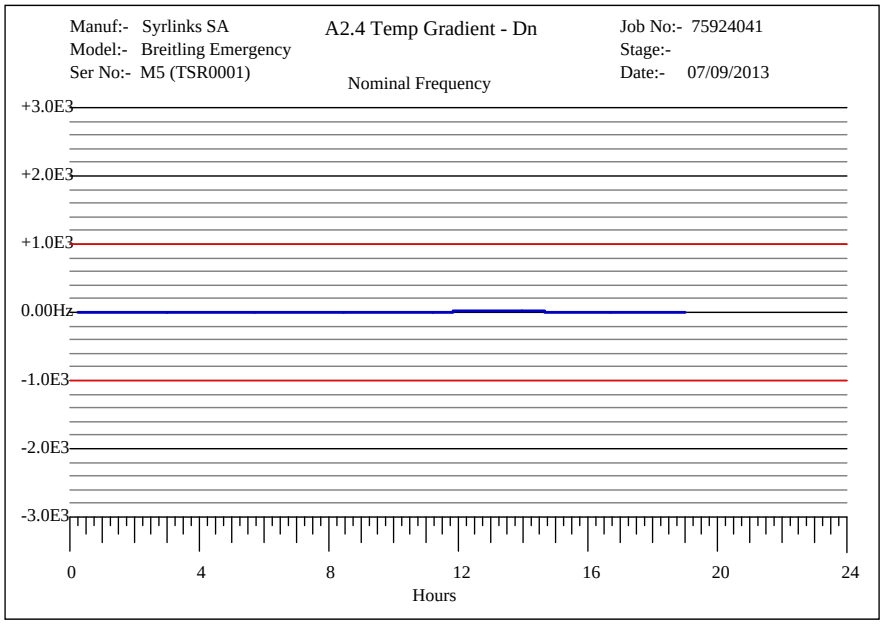


Digital Message

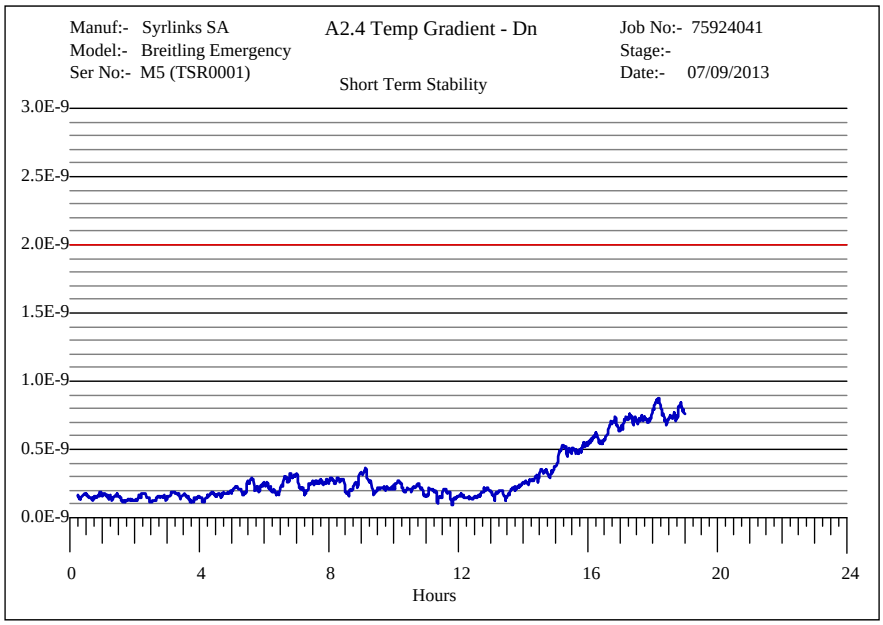
```
Beacon Id Format..... 22 Hex Id, Short Message, Bits 25-112
 15 Hex (Bits 26- 85) = AA4F0E1A4000001              AA4F0E1A4000001 Default_Id
 30 Hex (Bits 25-144) = 5527870D2000000BB31B8000000000

   26   30   34   38   42   46   50   54   58   62   66   70   74   78   82
   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
 0 1010 1010 0100 1111 0000 1110 0001 1010 0100 0000 0000 0000 0000 0000 0001
   0111 0110 0110 0011 0111 0000 0000 0000 0000 0000 0000 0000 0000 0000 000
   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
   86   90   94   98  102  106  110  114  118  122  126  130  134  138  142

Field Name        Bit Pos    Value Decode                                  Bits
----------        -------    ----- ------                                  ----
Format Flag        25            0 Short Message                             0
Protocol Flag      26            1 User                                      1
MID                27- 36      338 HAWAII                          0101 0100 10
User Protocol      37- 39        3 Serialized                           011
Beacon type        40- 42        6 Personal/ PLB                        110
Certification type 43            0 National                                0
Serial Number      44- 63   231056                       0011 1000 0110 1001 0000
National Use       64- 83        0                       0000 0000 0000 0000 0000
Manufacturer       44- 51       56 Unknown         NON-SPEC             0011 1000
Sequence Number    52- 63     1680                             0110 1001 0000
Model              64- 67        0                                        0000
Production Run     68- 75        0                                 0000 0000
U.S. Spare         76- 83        0 Hex=00                          0000 0000
Homing             84- 85        1 121.5                                 01
BCH Encoded        86-106          Errors=0           0111 0110 0110 0011 0111 0
BCH Generated      86-106                             0111 0110 0110 0011 0111 0
Emergency Cd Flag 107            0 National Use                              0
Beacon Activation 108            0 Manual only                               0
National Use      109-112                                                0000
```

Down Ramp

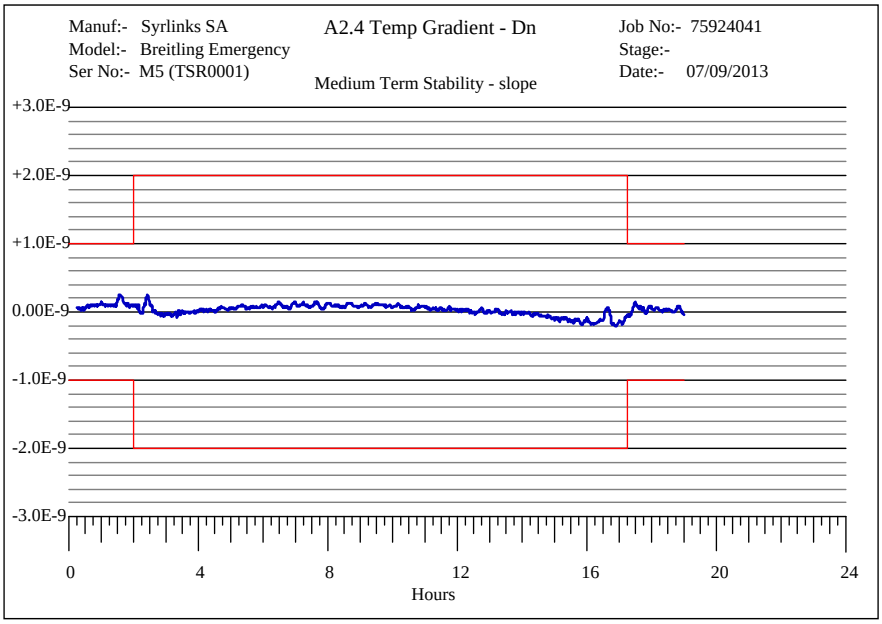
Nominal Frequency



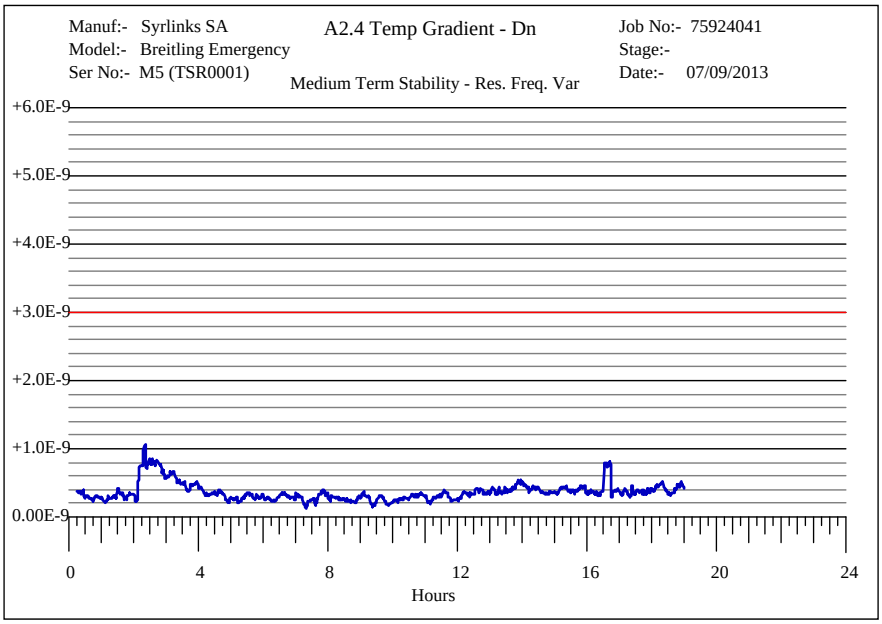
Short Term Stability



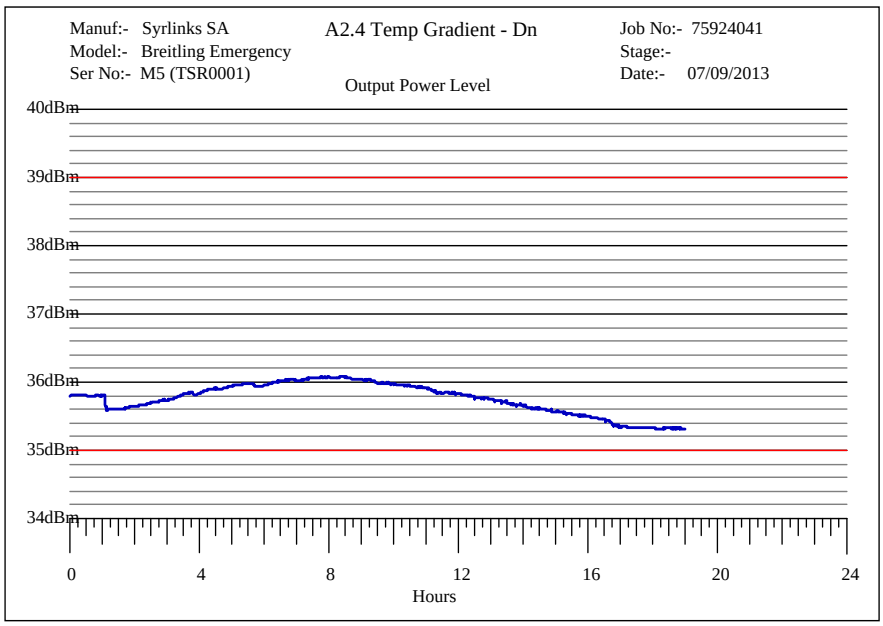
Medium Term Stability, Mean Slope



Medium Term Stability, Residual Frequency Variation



Output Power



Digital Message

```
Beacon Id Format..... 22 Hex Id, Short Message, Bits 25-112
 15 Hex (Bits 26- 85) = AA4F0E1A4000001              AA4F0E1A4000001 Default_Id
 30 Hex (Bits 25-144) = 5527870D2000000BB31B8000000000

   26   30   34   38   42   46   50   54   58   62   66   70   74   78   82
   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
 0 1010 1010 0100 1111 0000 1110 0001 1010 0100 0000 0000 0000 0000 0000 0001
   0111 0110 0110 0011 0111 0000 0000 0000 0000 0000 0000 0000 0000 0000 000
   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
   86   90   94   98  102  106  110  114  118  122  126  130  134  138  142

Field Name        Bit Pos    Value Decode                                  Bits
----------        -------    ----- ------                                  ----
Format Flag        25            0 Short Message                             0
Protocol Flag      26            1 User                                      1
MID                27- 36      338 HAWAII                          0101 0100 10
User Protocol      37- 39        3 Serialized                           011
Beacon type        40- 42        6 Personal/ PLB                        110
Certification type 43            0 National                                0
Serial Number      44- 63   231056                      0011 1000 0110 1001 0000
National Use       64- 83        0                      0000 0000 0000 0000 0000
Manufacturer       44- 51       56 Unknown         NON-SPEC             0011 1000
Sequence Number    52- 63     1680                              0110 1001 0000
Model              64- 67        0                                        0000
Production Run     68- 75        0                                   0000 0000
U.S. Spare         76- 83        0 Hex=00                            0000 0000
Homing             84- 85        1 121.5                                   01
BCH Encoded       86-106           Errors=0           0111 0110 0110 0011 0111 0
BCH Generated     86-106                              0111 0110 0110 0011 0111 0
Emergency Cd Flag 107             0 National Use                             0
Beacon Activation 108             0 Manual only                              0
National Use      109-112                                                0000
```

2.10 SATELLITE QUALITATIVE TESTS

2.10.1 Specification

Cospas-Sarsat T.007, Clause A.2.5

2.10.2 Equipment Under Test and Modification State

Emergency, S/N: M1 - Modification State 0

2.10.3 Date of Test

05 to 06 September 2013 & 06 to 07 September 2013

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 16.7 °C
Relative Humidity 65.4 %

2.10.6 Test Results

The EUT can be fitted with either a metal wrist strap, or a rubber wrist strap. The test was performed twice, once with each strap.

Product Service

Configuration 8 – EUT fitted with metal wrist strap

Test Start: 2013-09-06 17:06:18z
Test End: 2013-09-07 08:27:49z
15 Hex ID: AA5F0 00678 00001

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

Satellite ID	Satellite Pass Number	15 Hex ID Provided by LUT	Doppler Latitude	Doppler Longitude	Mean Rx Power (dBm)	TCA	CTA (deg)	Location Error (km)
S11	35718	AA5F0 00678 00001	50.81309	-1.20340	-123.78	23:04:20	-20.924	0.710
S13	5033	AA5F0 00678 00001	50.83089	-1.20321	-134.35	22:17:27	-13.188	1.460
S8	66811	AA5F0 00678 00001	50.82674	-1.19491	-131.19	21:57:57	-13.936	0.959
S11	35717	AA5F0 00678 00001	50.82151	-1.19006	-132.20	21:23:00	-4.954	0.632
S13	5032	AA5F0 00678 00001	50.82609	-1.20489	-125.88	20:36:52	2.556	1.014
S13	5031	AA5F0 00678 00001	50.75383	-1.34510	-133.58	18:57:41	16.599	12.604
S8	66810	AA5F0 00678 00001	50.82946	-1.21174	-130.45	20:16:44	1.923	1.598
S11	35716	AA5F0 00678 00001	50.82561	-1.20585	-134.15	19:43:09	10.089	1.007
S8	66809	AA5F0 00678 00001	50.83050	-1.22034	-135.58	18:36:57	15.966	2.105
S7	79646	AA5F0 00678 00001	50.82892	-1.18938	-125.75	17:19:00	-9.914	1.313
S7	79654	AA5F0 00678 00001	50.82631	-1.19483	-129.61	07:08:16	12.574	0.913
S7	79653	AA5F0 00678 00001	50.81480	-1.22711	-133.52	05:28:56	-2.068	2.117
S7	79652	AA5F0 00678 00001	50.82066	-1.20555	-130.52	03:48:10	-17.951	0.628
S12	23606	AA5F0 00678 00001	50.82277	-1.19459	-127.22	04:35:33	17.665	0.540
S10	42762	AA5F0 00678 00001	50.81030	-1.20459	-132.96	03:44:33	-5.941	1.017
S12	23605	AA5F0 00678 00001	50.82190	-1.19568	-129.33	02:55:50	3.972	0.423
S12	23604	AA5F0 00678 00001	50.81712	-1.28773	-138.34	01:14:43	-11.828	6.339

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

$= \frac{15}{17}$

$= 88.2\%$

Product Service

Configuration 8 – EUT fitted with rubber wrist strap

Test Start: 2013-09-05 17:23:40
Test End: 2013-09-06 08:06:10
15 Hex ID: AA5F0 00678 00001

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

Satellite ID	Satellite Pass Number	15 Hex ID Provided by LUT	Doppler Latitude	Doppler Longitude	Mean Rx Power (dBm)	TCA	CTA (deg)	Location Error (km)
S13	5019	AA5F0 00678 00001	50.81058	-1.19073	-127.40	22:38:27	-16.516	0.976
S8	66797	AA5F0 00678 00001	50.82942	-1.19356	-124.87	22:10:20	-15.910	1.270
S11	35704	AA5F0 00678 00001	50.82221	-1.18972	-124.95	21:43:50	-8.239	0.698
S11	35703	AA5F0 00678 00001	50.69286	-1.31680	-114.33	20:03:40	7.266	16.266
S13	5017	AA5F0 00678 00001	50.82791	-1.20976	-127.00	19:18:05	13.846	1.377
S8	66795	AA5F0 00678 00001	50.83148	-1.21834	-129.96	18:48:58	14.410	2.075
S11	35702	AA5F0 00678 00001	50.82954	-1.22554	-128.69	18:24:56	20.124	2.336
S7	79632	AA5F0 00678 00001	50.82704	-1.18949	-125.57	17:43:40	-13.830	1.124
S7	79639	AA5F0 00678 00001	50.81602	-1.17868	-120.80	05:53:21	1.729	1.341
S10	42749	AA5F0 00678 00001	50.82382	-1.19499	-118.04	05:36:09	10.810	0.641
S12	23592	AA5F0 00678 00001	50.82517	-1.19026	-117.07	04:46:12	18.936	0.919
S7	79638	AA5F0 00678 00001	50.81189	-1.20735	-129.94	04:12:57	-14.038	0.992
S10	42748	AA5F0 00678 00001	50.81355	-1.21512	-126.48	03:55:45	-4.169	1.346
S12	23591	AA5F0 00678 00001	50.82345	-1.19420	-114.49	03:06:38	5.582	0.620
S10	42747	AA5F0 00678 00001	50.80062	-1.20168	-132.24	02:13:52	-20.239	1.983
S12	23590	AA5F0 00678 00001	50.81954	-1.20996	-128.32	01:25:40	-10.037	0.889

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

$$= \frac{15}{16}$$

$$= 93.75\%$$

2.11 BEACON ANTENNA TEST

2.11.1 Specification

Cospas-Sarsat T.007, Clause A.2.6

2.11.2 Equipment Under Test and Modification State

Emergency, S/N: M1 - Modification State 0

2.11.3 Date of Test

05 September 2013

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 18.0 °C
Relative Humidity 52.0 %

2.11.6 Test Results

The EUT can be fitted with either a metal wrist strap, or a rubber wrist strap. The test was performed twice, once with each strap fitted. The test was carried out in Configuration 4; however, in accordance with Worksheet-02 (case 2013-06) further measurements were made at the full 60 measurement points. Note that the maximum number of strikeouts was maintained at 80 % as per T.007 B.10.2.

Additional measurements have also been made with the EUT in self-test mode.

Configuration 4 (figure B.5) - EUT fitted with metal wrist strap

	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	35.9	0.58	~~29.1~~	-6.29	38.4	3.04	39.6	4.29	34.3	-1.08
30	36.1	0.70	~~26.6~~	-8.73	37.7	2.36	39.1	3.75	33.9	-1.47
60	36.3	0.92	~~22.6~~	-12.80	36.9	1.52	38.6	3.28	33.2	-2.15
90	36.7	1.36	~~24.1~~	-11.27	36.6	1.20	38.2	2.84	33.0	-2.40
120	36.9	1.59	~~26.7~~	-8.65	36.8	1.49	38.7	3.35	33.1	-2.30
150	37.1	1.73	~~29.8~~	-5.58	37.4	2.07	39.4	4.07	33.8	-1.53
180	36.9	1.55	~~30.1~~	-5.22	38.0	2.63	39.8	4.47	34.7	-0.69
210	36.5	1.14	~~28.9~~	-6.49	38.4	3.06	40.3	4.95	35.2	-0.12
240	36.0	0.67	~~28.0~~	-7.40	38.9	3.50	40.6	5.24	35.8	0.49
270	35.7	0.38	~~28.7~~	-6.69	39.1	3.77	40.5	5.16	36.1	0.74
300	35.8	0.47	~~29.1~~	-6.27	38.9	3.58	40.3	4.91	36.0	0.61
330	35.9	0.57	~~29.5~~	-5.86	38.7	3.32	39.9	4.56	36.0	0.62

	Elevation Angle (degrees)									
	10		20		30		40		50	
Azimuth Angle (Degrees)	Vv	Vh	Vv	Vh	Vv	Vh	Vv	Vh	Vv	Vh
0	105.00	92.32	96.66	92.03	106.30	94.43	106.60	92.18	99.75	83.99
30	105.20	90.61	94.37	89.13	105.70	92.10	106.10	90.49	99.42	80.09
60	105.50	87.19	91.21	78.59	105.00	85.46	105.70	85.62	98.77	75.24
90	106.00	78.50	91.70	87.01	104.70	83.69	105.30	70.69	98.49	79.53
120	106.20	84.94	93.17	91.89	104.80	91.89	105.80	80.33	98.52	83.16
150	106.30	88.87	93.81	96.94	105.20	95.07	106.50	85.10	99.30	83.58
180	106.10	89.75	93.95	97.40	105.80	95.17	106.90	85.72	100.20	80.63
210	105.70	88.57	94.46	95.00	106.40	92.81	107.40	81.78	100.80	76.61
240	105.30	81.95	95.30	91.60	107.00	85.47	107.70	68.63	101.40	79.16
270	105.00	82.66	97.11	87.33	107.30	77.33	107.60	85.33	101.60	84.40
300	105.00	89.20	97.63	86.66	107.00	91.22	107.30	89.52	101.40	86.97
330	105.00	92.07	97.24	92.02	106.60	94.25	106.90	91.48	101.40	87.27
Min (Vv-Vh)	12.68		-3.45		10.13		14.42		14.13	

$EIRP_{LOSS} = Pt_{ambient} - Pt_{EOL} =$ 35.8 - 34.5 = 1.25 dB

$EIRP_{maxEOL} = Max[EIRP_{max}, (EIRP_{max} - EIRP_{LOSS})] =$ Max[40.6, 39.3]= 40.6 dBm

$EIRP_{minEOL} = Min[EIRP_{min}, (EIRP_{min} - EIRP_{LOSS})] =$ Min[33.0, 31.7]= 31.7 dBm

Product Service

Configuration 4 (figure B.5) - EUT fitted with Rubber wriststrap

	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	35.1	-0.22	~~27.9~~	-7.47	37.9	2.59	39.0	3.67	34.9	-0.49
30	35.6	0.29	~~25.0~~	-10.39	38.0	2.69	38.7	3.38	34.3	-1.04
60	36.3	0.99	~~23.6~~	-11.77	37.5	2.18	38.2	2.88	34.2	-1.10
90	36.9	1.58	~~23.8~~	-11.55	36.9	1.58	38.1	2.77	33.9	-1.45
120	37.2	1.88	~~25.5~~	-9.83	36.1	0.79	38.1	2.75	33.3	-2.09
150	37.2	1.89	~~26.2~~	-9.18	35.9	0.50	38.3	2.97	33.3	-2.08
180	37.0	1.68	~~26.4~~	-8.96	36.0	0.61	38.6	3.25	33.7	-1.67
210	36.5	1.17	~~26.7~~	-8.68	36.3	0.99	38.9	3.55	34.1	-1.21
240	35.9	0.57	~~27.9~~	-7.50	37.5	2.18	39.2	3.85	34.6	-0.70
270	35.4	0.07	~~28.6~~	-6.77	37.8	2.48	39.3	3.95	34.8	-0.57
300	35.1	-0.23	~~29.5~~	-5.80	38.0	2.68	39.3	3.95	35.1	-0.21
330	34.9	-0.41	~~28.7~~	-6.67	38.0	2.70	39.3	3.99	36.8	1.48

	Elevation Angle (degrees)									
	10		20		30		40		50	
Azimuth Angle (Degrees)	Vv	Vh	Vv	Vh	Vv	Vh	Vv	Vh	Vv	Vh
0	104.40	81.74	96.61	82.24	106.10	82.48	106.10	85.63	100.30	85.67
30	104.90	83.60	93.55	82.14	106.20	81.65	105.80	85.51	99.80	83.67
60	105.60	84.31	91.99	82.69	105.70	79.42	105.30	85.24	99.79	80.15
90	106.20	84.46	91.83	85.23	105.10	76.28	105.20	83.95	99.46	78.38
120	106.50	84.54	93.42	87.51	104.30	79.73	105.20	80.45	98.83	75.66
150	106.50	85.46	93.97	88.50	104.00	82.75	105.40	83.73	98.81	79.81
180	106.30	84.65	94.30	88.33	104.10	83.91	105.70	80.13	99.18	82.33
210	105.80	81.49	95.00	86.40	104.50	80.56	106.00	81.73	99.58	85.15
240	105.20	79.18	96.57	82.63	105.70	76.32	106.30	80.12	100.10	85.21
270	104.70	79.45	97.40	79.48	106.00	77.70	106.40	80.45	100.30	82.52
300	104.40	80.87	98.41	76.25	106.20	80.32	106.40	82.41	100.70	78.94
330	104.20	83.17	97.50	79.23	106.20	83.93	106.40	87.10	102.40	78.95
Min (Vv-Vh)	21.03		5.47		20.19		19.30		14.43	

$EIRP_{LOSS} = Pt_{ambient} - Pt_{EOL} =$ 35.8 - 34.5 = 1.25 dB

$EIRP_{maxEOL} = Max[EIRP_{max}, (EIRP_{max} - EIRP_{LOSS})] =$ Max[39.3, 38.1]= 39.3 dBm

$EIRP_{minEOL} = Min[EIRP_{min}, (EIRP_{min} - EIRP_{LOSS})] =$ Min[33.3, 32.0]= 32.0 dBm

Additional Antenna Measurements (during Self-Test)

The EUT was placed in the battery charger, where, once fully charged, the EUT would perform a self-test. To enable multiple measurements, the AC power to the charger was cycled ON/OFF/ON; after a short period the EUT would self-test again. The manufacturer has declared that no RF transmission is made during a self-test, because the antenna is not deployed in this configuration.

Measurements were made with the measuring antenna at elevations between 10 and 50°, and the EUT positioned with the azimuth set at 30° intervals (as per the Measurements Requirements in section B.7.2.1)

The worst-case result found during the measurements was a level of 40.4 dBµV; that equates to -27.77 dBm (1.67 µW).

2.12 BEACON CODING SOFTWARE

2.12.1 Specification

Cospas-Sarsat T.007, Clause A.2.8

2.12.2 Equipment Under Test and Modification State

Emergency, S/N: M5 - Modification State 1

2.12.3 Date of Test

16 September 2013

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 22.0 °C
Relative Humidity 46.3 %

2.12.6 Test Results

Protocol	Operational Message	Self-Test Message
Serial User: PLB with Serial Number	FFFE2F5527870D2000000BB31B80	FFFED05527870D2000000BB31B80

SECTION 3

TEST EQUIPMENT USED

3.1 TEST EQUIPMENT

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

Instrument	Manufacturer	Type No.	TE No.	Calibration Period (months)	Calibration Due
Section 2.1, 2.2, 2.4 and 2.5 - Constant Temperature Tests					
Power Meter	Hewlett Packard	436A	47	12	12-Jul-2014
Climatic Chamber	Heraeus Votsch	VM 04/100	85	-	O/P Mon
Rubidium Frequency Standard	Quartzlock	A10-B	92	12	25-Jan-2014
Time Interval Analyser	Yokogawa	TA720	181	12	22-Apr-2014
3dB/10W Attenuator	Texscan	HFP-50N	475	12	27-Mar-2014
Signal Generator (100kHz to 2.6GHz)	Hewlett Packard	8663A	1063	12	3-Apr-2014
Spectrum Analyser	Agilent Technologies	E4407B	1154	12	13-Aug-2014
Distress Beacon RF Unit	TUV SUD Product Service	-	2445	-	TU
Stop Clock	R.S Components	RS328 061	2674	12	28-Jun-2014
Termination (50ohm, 1W)	Suhner		3080	12	4-Mar-2014
Termination (50ohm, 2W)	Omni-Spectra	3001-6100	3081	12	4-Mar-2014
Attenuator (20dB, 10W)	Aeroflex / Weinschel	23-20-34	3158	12	27-Jun-2014
Thermocouple Thermometer	Fluke	51	3172	12	21-Aug-2014
Bandpass Filter	Trilithic	5BE406/35-1-AA	3205	12	21-Aug-2014
Power Sensor	Agilent Technologies	8482A	3290	12	14-Jan-2014
Cable (1m, N Type)	Rhophase	NPS-1601-1000-NPS	3352	12	19-Apr-2014
Cable (1m, N Type)	Rhophase	NPS-1601-1000-NPS	3354	12	19-Apr-2014
ScopeCorder	Yokogawa	DL750	4175	12	8-Nov-2013
Section 2.3 - Spurious Emissions into 50 Ohms					
Climatic Chamber	Heraeus Votsch	VM 04/100	85	-	O/P Mon
Rubidium Frequency Standard	Quartzlock	A10-B	92	12	25-Jan-2014
3dB/10W Attenuator	Texscan	HFP-50N	475	12	27-Mar-2014
Spectrum Analyser	Agilent Technologies	E4407B	1154	12	13-Aug-2014
Attenuator (20dB, 10W)	Aeroflex / Weinschel	23-20-34	3158	12	27-Jun-2014
Thermocouple Thermometer	Fluke	51	3172	12	21-Aug-2014
Bandpass Filter	Trilithic	5BE406/35-1-AA	3205	12	21-Aug-2014
Cable (1m, N Type)	Rhophase	NPS-1601-1000-NPS	3351	12	19-Apr-2014
Cable (1m, N Type)	Rhophase	NPS-1601-1000-NPS	3354	12	19-Apr-2014
Section 2.6 - Thermal Shock					
Climatic Chamber	Heraeus Votsch	VMT 04/30	40	-	O/P Mon
Power Meter	Hewlett Packard	436A	47	12	12-Jul-2014
Climatic Chamber	Heraeus Votsch	VM 04/100	85	-	O/P Mon
Rubidium Frequency Standard	Quartzlock	A10-B	92	12	25-Jan-2014
Time Interval Analyser	Yokogawa	TA720	181	12	22-Apr-2014
3dB/10W Attenuator	Texscan	HFP-50N	475	12	27-Mar-2014
Signal Generator (100kHz to 2.6GHz)	Hewlett Packard	8663A	1063	12	3-Apr-2014
Beacon RF Unit	TUV SUD Product Service	N/A	3066	-	TU
Termination (50ohm, 2W)	Omni-Spectra	3001-6100	3081	12	4-Mar-2014
Attenuator (20dB, 10W)	Aeroflex / Weinschel	23-20-34	3158	12	27-Jun-2014
Thermocouple Thermometer	Fluke	51	3172	12	21-Aug-2014
Bandpass Filter	Trilithic	5BE406/35-1-AA	3205	12	21-Aug-2014
Power Sensor	Agilent Technologies	8482A	3290	12	14-Jan-2014
Cable (1m, N Type)	Rhophase	NPS-1601-1000-NPS	3351	12	19-Apr-2014
Cable (1m, N Type)	Rhophase	NPS-1601-1000-NPS	3354	12	19-Apr-2014
ScopeCorder	Yokogawa	DL750	4175	12	8-Nov-2013

Instrument	Manufacturer	Type No.	TE No.	Calibration Period (months)	Calibration Due
Section 2.7 - Battery Current Measurements					
Climatic Chamber	Votsch	VT4002	161	-	O/P Mon
Multimeter	White Gold	WG022	190	12	30-Oct-2013
Power Supply	Iso-tech	IPS 2010	2440	-	O/P Mon
Thermocouple Thermometer	Fluke	51	3172	12	21-Aug-2014
8 Channel Datalogger + Terminal Board	Pico Technology Ltd	ADC-16	3287	12	13-Dec-2013
Resistor (Nominal 0.25ohm)	TUV SUD Product Service	2x RS Components 188-071 R5/100W Resistors	3343	12	22-Oct-2013
Section 2.7 and 2.8 - Operating Lifetime at Minimum Temperature and Operating Lifetime at 0°C (Additional Testing)					
Power Meter	Hewlett Packard	436A	47	12	12-Jul-2014
Climatic Chamber	Heraeus Votsch	VM 04/100	85	-	O/P Mon
Beacon Tester	WS Technologies	BT 100S	87	-	TU
Rubidium Frequency Standard	Quartzlock	A10-B	92	12	25-Jan-2014
Time Interval Analyser	Yokogawa	TA720	181	12	22-Apr-2014
Attenuator 10dB/10W)	Trilithic	HFP-50N	454	12	7-Aug-2014
3dB/10W Attenuator	Texscan	HFP-50N	475	12	27-Mar-2014
Attenuator (10dB)	Weinschel	47-10-34	481	12	27-Mar-2014
Broadband Resistive Power Divider	Weinschel	1506A	601	12	19-Mar-2014
Signal Generator (100kHz to 2.6GHz)	Hewlett Packard	8663A	1063	12	3-Apr-2014
Spectrum Analyser	Agilent Technologies	E4407B	1154	12	13-Aug-2014
Attenuator (10dB, 10W)	Trilithic	HFP-50N	1377	12	19-Oct-2013
Distress Beacon RF Unit	TUV SUD Product Service	-	2445	-	TU
Termination (50ohm, 1W)	Suhner		3080	12	4-Mar-2014
Attenuator (20dB, 10W)	Aeroflex / Weinschel	23-20-34	3158	12	27-Jun-2014
Thermocouple Thermometer	Fluke	51	3172	12	21-Aug-2014
Bandpass Filter	Trilithic	5BE406/35-1-AA	3205	12	21-Aug-2014
Power Sensor	Agilent Technologies	8482A	3290	12	14-Jan-2014
Cable (1m, N Type)	Rhophase	NPS-1601-1000-NPS	3352	12	19-Apr-2014
Cable (1m, N Type)	Rhophase	NPS-1601-1000-NPS	3354	12	19-Apr-2014
Bandpass Filter	Trilithic	5BE121.55/35-3-BA	3410	12	14-Sep-2013
2 Metre N Type Cable	Rhophase	NPS-1601A-2000-NPS	4109	12	11-Jun-2014
ScopeCorder	Yokogawa	DL750	4175	12	8-Nov-2013
Section 2.9 - Frequency Stability Test with Temperature Gradient					
Power Meter	Hewlett Packard	436A	47	12	12-Jul-2014
Climatic Chamber	Heraeus Votsch	VM 04/100	85	-	O/P Mon
Rubidium Frequency Standard	Quartzlock	A10-B	92	12	25-Jan-2014
Time Interval Analyser	Yokogawa	TA720	181	12	22-Apr-2014
3dB/10W Attenuator	Texscan	HFP-50N	475	12	27-Mar-2014
Signal Generator (100kHz to 2.6GHz)	Hewlett Packard	8663A	1063	12	3-Apr-2014
Distress Beacon RF Unit	TUV SUD Product Service	-	2445	-	TU
Termination (50ohm, 1W)	Suhner		3080	12	4-Mar-2014
Termination (50ohm, 2W)	Omni-Spectra	3001-6100	3081	12	4-Mar-2014
Attenuator (20dB, 10W)	Aeroflex / Weinschel	23-20-34	3158	12	27-Jun-2014
Thermocouple Thermometer	Fluke	51	3172	12	21-Aug-2014
Bandpass Filter	Trilithic	5BE406/35-1-AA	3205	12	21-Aug-2014
Power Sensor	Agilent Technologies	8482A	3290	12	14-Jan-2014
Cable (1m, N Type)	Rhophase	NPS-1601-1000-NPS	3352	12	19-Apr-2014
Cable (1m, N Type)	Rhophase	NPS-1601-1000-NPS	3354	12	19-Apr-2014
ScopeCorder	Yokogawa	DL750	4175	12	8-Nov-2013

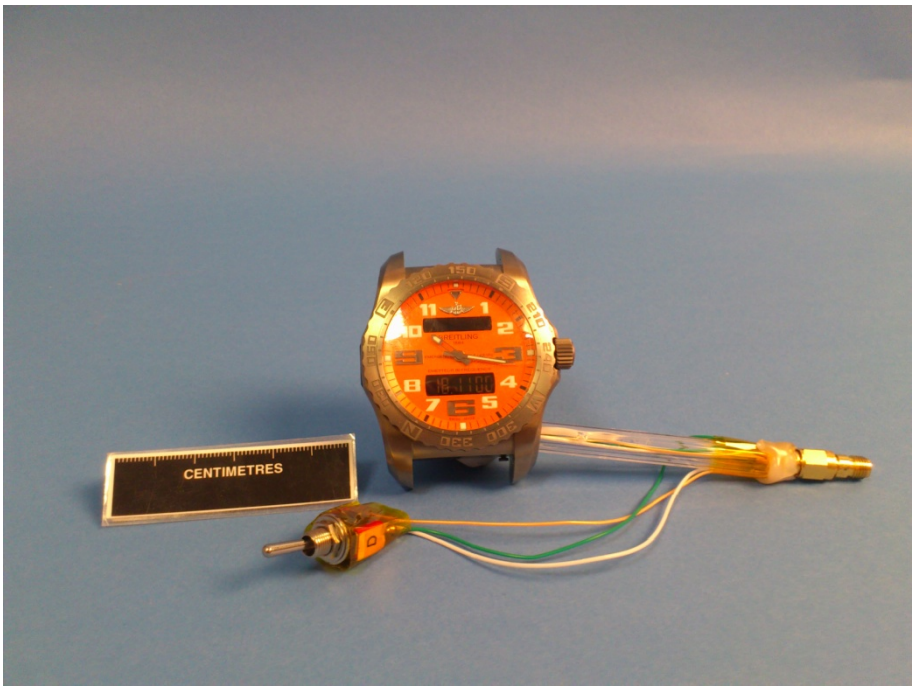
Instrument	Manufacturer	Type No.	TE No.	Calibration Period (months)	Calibration Due
Section 2.10 - Satellite Qualitative Test					
Beacon Tester	WS Technologies	BT100S	3263	-	TU
Humidity and Temperature Meter	R.S Components	1361C	3844	12	22-Mar-2014
Section 2.11 – Beacon Antenna Test					
Turntable/Mast Controller	EMCO	2090	1607	-	TU
Roberts Antenna 406MHz	Compliance Design		1860	24	10-Jan-2014
ESA-E Series Spectrum Analyser	Agilent Technologies	E4402B	3348	12	13-Jun-2014

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

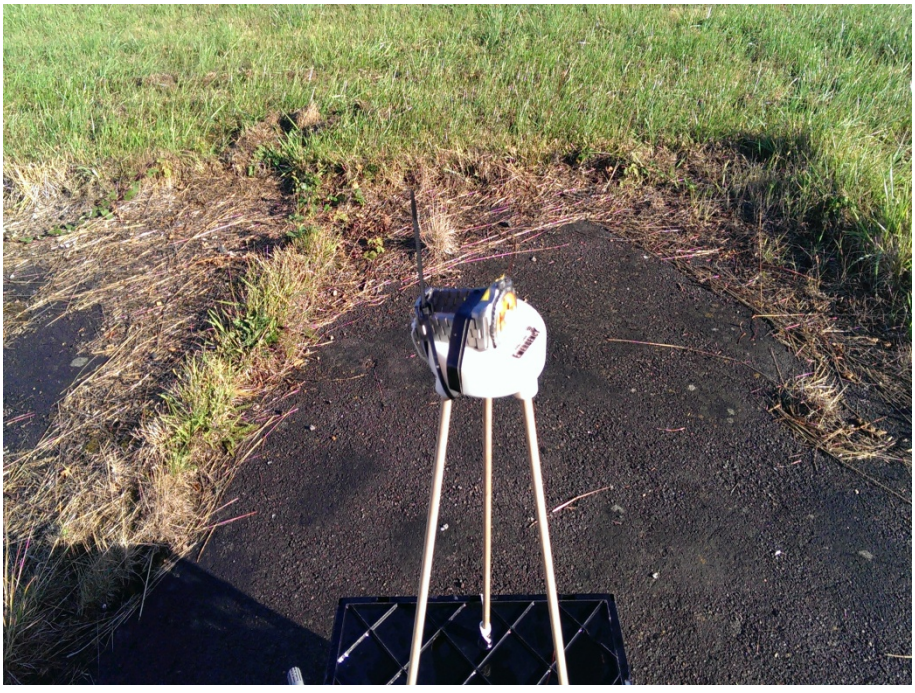
SECTION 4

PHOTOGRAPHS

4.1 PHOTOGRAPHS OF EQUIPMENT UNDER TEST (EUT)

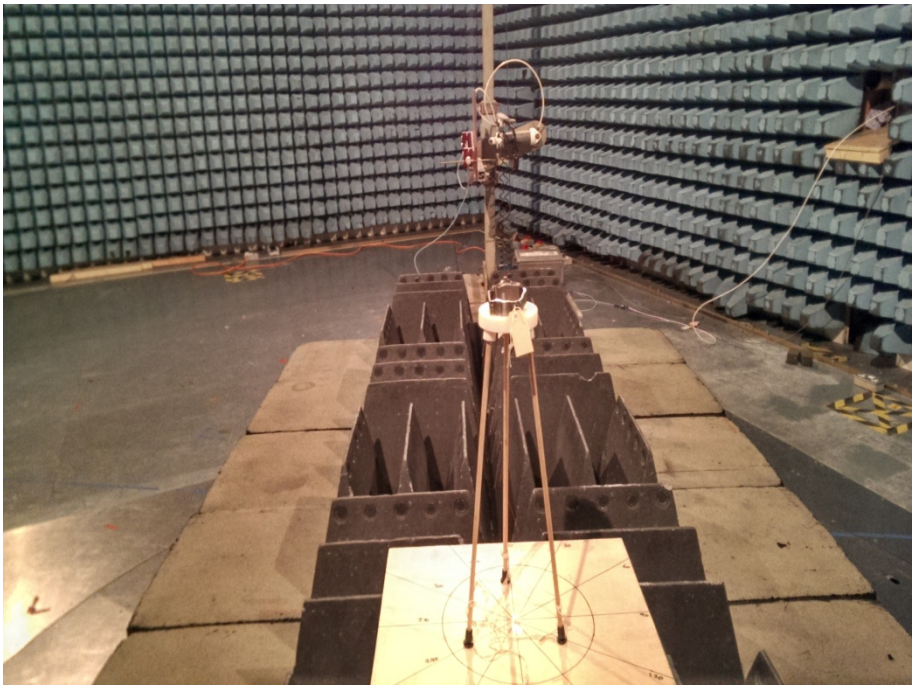


Front View

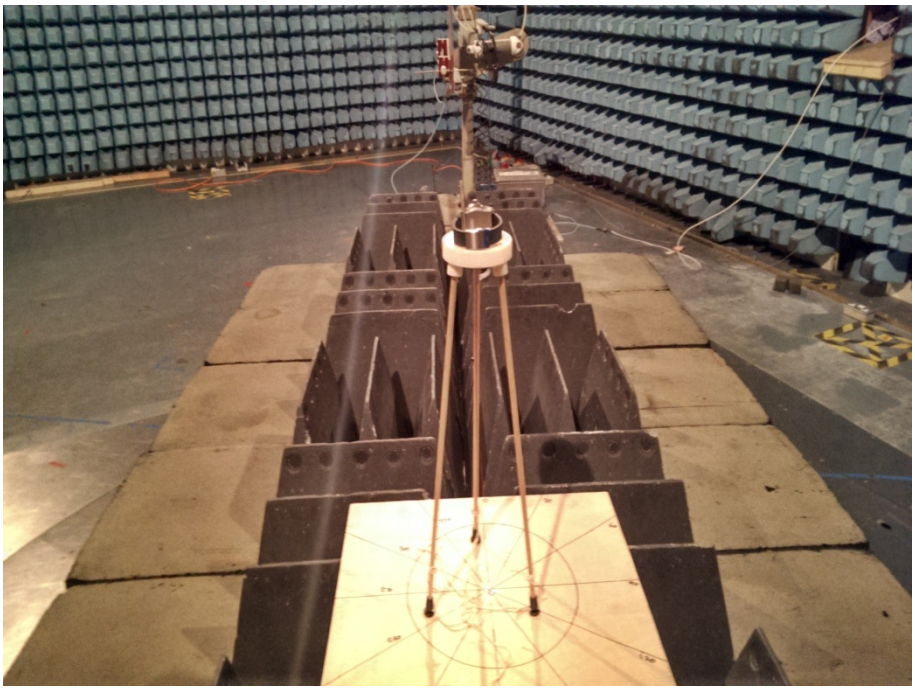


Satellite Qualitative - Configuration 8 (Metal Strap)

Satellite Qualitative - Configuration 8 (Rubber Strap)



Antenna Characteristics - Configuration 4 (Metal Strap)



Antenna Characteristics - Configuration 4 (Rubber Strap)

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'S SUPPLIED DATA

Appendix to Annex G - LIRB

Beacon Characteristics (for rechargeable batteries) – BREITLING EMERGENCY

Characteristic	Specification
Operating temperature range	Tmin = -20°C Tmax=55°C
Operating lifetime	18 Hours
Battery chemistry	Li-Ion NMC / Si
Battery cell model name, size and number of cells	1INP63438 Size 34x37x5,9mm / 1 cell
Battery cell manufacturer	PROLLION, GRENOBLE, FR
Battery pack manufacturer and part number	PROLLION, GRENOBLE, FR S/N=PLB-00018
Initial capacity of new battery after first charge	*1150 mAh*
Required capacity to meet the operating life time at minimum temperature	*860mAh*
Battery replacement life time	*24 Months = 2 Years*
Charge indication	☒ *Visual* / ☐ *Audio* ☒ *In Normal Mode* / ☒ *Not in Normal mode* ☒ *Charge Ongoing* ☒ *Charge Complete* *Type : External charger with LED (see description in the user manual)*
Time Between Recommended Charges at ambient temperature (TBRC)	*2 Months*
$T_{wake\text{-}up}$ *(wake-up period to check battery)*	*0.25Days (6 Hours)*
$R_{discharge}$ *(resistor for discharge process)*	*21* Ω
Reversible losses between TBRC: $C_{reversible\_losses}$	*1.7 %*
Voltage drop after TBRC: $V_{partial\_discharge\_mean}$	*0.12 V*
Irreversible losses during TBRC: $C_{irreversible\_losses\_between\_TBRC}$	*2.0 %*
Activation Energy Ea	*36 341* $J.mol^{-1}$
Test temperature (if applicable) for measurement of irreversible capacity loss during storage	*34 °C -*
Worst Case Life Time (WCLT)	*4 Months*

Characteristic	Specification
*Irreversible losses in **two-year storage**: $C_{irreversible\_loss\_in\_storage}$*	*3.5 % This is the **value for one-year storage**, as the maximum storage duration is one year.*
Test temperature (if applicable) for measurement of irreversible capacity loss in standby mode	*50 °C*
Irreversible losses in standby mode over replacement life time: $C_{irreversible\_loss\_in\_standby\_mode}$	*7 %*
Measured operating life time in Worst Case Life Time configuration	*>18 Hours*
Battery Charger	
$I_{charge\_initial}$	*200 mA*
I_{charge_final}	*20 mA*
$V_{charge\_initial}$	*2.5 V*
V_{charge_final}	*4.2 V*
Charge time : t_{end_charge}	*Up to 360 Min (6 Hours)*
Charge capacity	*1150 mAh*
Oscillator type (e.g. OCXO, MCXO, TCXO) …	TCXO

Characteristic	Specification	
Self-Test Mode Characteristics:	Self-Test Mode	Optional GNSS Self-Test Mode
[…]		
- Maximum number of GNSS Self-Tests (beacons with internal navigation devices only)	N/A	N/A
- *Self-test automatically activated after each charge process (for beacon using rechargeable batteries)*	YES	N/A

Product Service

Manufacturer Technical Data

Syrlinks

Reference		Customer	Date
		Breitling	17/09/2013
Project		**Révision**	
Emergency Watch		1.2	
Title		**Author**	
Technical description needed by C/S		Jean-Hervé Corre	
Distribution	Breitling		
	Cospas-Sarsat		

Watch Emergency

-

Technical description needed by Cospas-Sarsat

REVISIONS

Version	Date	Author	Comments
V1.0	04/12/2012	JH Corre	Creation
V1.1	06/03/2013	JH Corre	update
V1.2	17/09/2013	JM Le Merdy	validation

Table of content

1. INTRODUCTION

The goal of this document is to demonstrate to C/S that the design (Extract of the C/S T007 §5 section j and d):

- provides protection against continuous transmission (see section A.3.4),
- meets the frequency stability requirements over 5 years (see section A.3.5),
- provides protection from repetitive self-test mode transmissions (see section A.3.6),
- ensures that the self-test messages (except for GNSS self-test) have default values encoded in position fields, at all times and irrespectively of the navigation data input, and
- provides protection against erroneous position encoding into the beacon message (see section 4.5.5 of C/S T.001);
- description of operating mode

2. PROTECTION AGAINST CONTINUOUS TRANSMISSION

The protection against continuous transmission is guaranty by design. In fact the 406MHz modulation and transmission is controlled and scheduled by a state machine coded in the microcontroller. The system use a Real-Time-Clock based on a 32KHz quartz.

On the other hand, the 406MHz amplifier chain contains a driver stage following by the power amplifier (see figure 1) . These 2 stages are controlled and scheduled by the electronic as:

- The driver is switch on with a signal (gate command) coming from a Digital-to-Analog-Converter (DAC),
- The power amplifier is controlled with a signal (gate command) coming from another DAC.

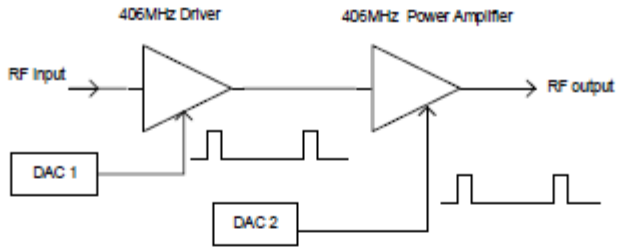


Figure 1 – View of the 406MHz amplification

That means the 406MHz RF signal at input of the amplifier stages (RF input) is only available when it is generated and scheduled by the Firmware, and in addition the driver and the power amplifier are switch off (controlled trough DAC 1 and DAC 2) outside the 406MHz burst.

3. FREQUENCY STABILITY REQUIREMENT OVER 5 YEARS

The reference oscillator of the beacon used to generate the frequency 406.04MHz and 121.5MHz is provided by Rakon (Ref .E5829LFT). This oscillator doesn't require temperature compensation. It is a C/S compliant reference.

The frequency stability for the first year and over 10 years are given by the oscillator data sheet:

Ageing, first year	≤ ± 1.0 ppm
Ageing, 10 years	≤ ± 3.0 ppm

Long-term frequency stability over 5 years is demonstrated by measurement made by Rakon. The test of long term stability is performed as mentioned in C/S T 007 issue 4 revision 5 on 28 samples.

Summary of the Rakon's results:

SUMMARY OF TEST RESULTS			
TEST	PASS	FAIL	REMARKS
Residual (5-year prediction)	28	0	Minimum Cpk = 1.69
Minimum Static Slope (5-year prediction)	28	0	Minimum Cpk = 9.28
Maximum Static Slope (5-year prediction	28	0	Minimum Cpk = 12.44
Minimum Gradient Slope (5-year prediction)	28	0	Minimum Cpk = 9.31
Maximum Gradient Slope (5-year prediction	28	0	Minimum Cpk = 6.86
Aging Mid Frequency (5-year prediction)	28	0	Minimum Cpk = 9.99

The details of the results are given in the following table:

Residual (ppb)

Maximum	1,007	
Minimum	-0,255	
Mean	0,446	
Standard Deviation	0,287	
Upper Spec. Limit	3,000	
	2 Sigma (95% Conf.)	3 Sigma (99% Co
Calc. Max. value	1,021	1,308
Cpk (Upper)	n/a	1,052

Minimum Static Slope (ppb/min)

Maximum	-0,865	
Minimum	-0,918	
Mean	-0,843	
Standard Deviation	0,034	
Upper Spec. Limit	1,000	
Lower Spec. Limit	-1,000	
	2 Sigma (95% Conf.)	3 Sigma (99% Conf.)
Calc. Max. value	-0,826	-0,860
Calc. Min. value	-0,912	-0,146
Cpk (Upper)	n/a	38,911
Cpk (Lower)	n/a	9,275

Maximum Static Slope (ppb/min)

Maximum	0,128	
Minimum	0,029	
Mean	0,085	
Standard Deviation	0,025	
Upper Spec. Limit	1,000	
Lower Spec. Limit	-1,000	
	2 Sigma (95% Conf.)	3 Sigma (99% Conf.)
Calc. Max. value	0,134	0,158
Calc. Min. value	0,036	0,011
Cpk (Upper)	n/a	12,437
Cpk (Lower)	n/a	14,737

Minimum gradient Slope (ppb/min)

Maximum	-0,144	
Minimum	-0,383	
Mean	-0,253	
Standard Deviation	0,065	
Upper Spec. Limit	2,000	
Lower Spec. Limit	-2,000	
	2 Sigma (95% Conf.)	3 Sigma (99% Conf
Calc. Max. value	-0,128	-0,065
Calc. Min. value	-0,378	-0,440
Cpk (Upper)	n/a	12,083
Cpk (Lower)	n/a	9,393

Maximum gradient Slope (ppb/min)

Maximum	0,460	
Minimum	0,186	
Mean	0,320	
Standard Deviation	0,082	
Upper Spec. Limit	2,000	
Lower Spec. Limit	-2,000	
	2 Sigma (95% Conf.)	3 Sigma
Calc. Max. value	0,484	
Calc. Min. value	0,157	
Cpk (Upper)	n/a	
Cpk (Lower)	n/a	

Aging Mid Frequency (ppm)

Maximum	0,675	
Minimum	0,090	
Mean	0,264	
Standard Deviation	0,155	
Upper Spec. Limit	4,925	
Lower Spec. Limit	-12,315	
	2 Sigma (95% Conf.)	3 Sigma (99% C
Calc. Max. value	0,575	0,730
Calc. Min. value	-0,047	-0,202
Cpk (Upper)	n/a	9,998
Cpk (Lower)	n/a	26,981

For more information you can see the Excel file "*data 2012_123 E5829LFT MTS.xlsx*".

4. PROVIDES PROTECTION FROM REPETITIVE SELF-TEST MODE TRANSMISSIONS

The beacon embedded in the watch is delivered to the final customer with a charger. This charger is used to recharge the rechargeable battery in each 2 months. The charger is powered with an AC/DC wall plug converter.

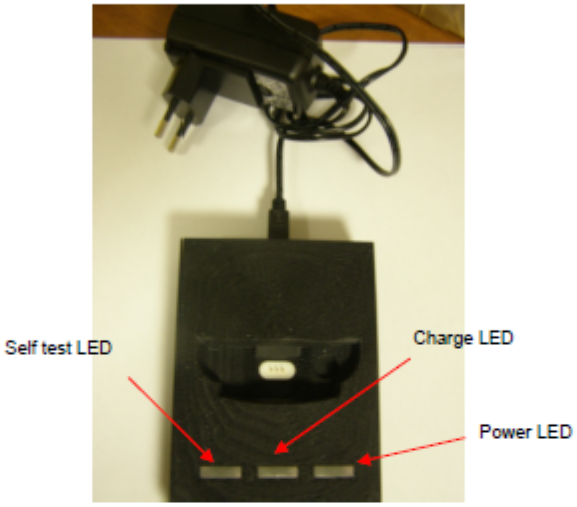


Figure 2 – View of the charger

As mentioned in the *Emergency Watch* User Manual each 2 months the user put his watch on the charger in order to recharge the battery. At the end of the charge a self test is automatically launch.

5. ENSURES THAT THE SELF-TEST MESSAGES (EXCEPT FOR GNSS SELF-TEST) HAVE DEFAULT VALUES ENCODED IN POSITION FIELDS, AT ALL TIMES AND IRRESPECTIVELY OF THE NAVIGATION DATA INPUT

Not applicable.

6. PROVIDES PROTECTION AGAINST ERRONEOUS POSITION ENCODING INTO THE BEACON MESSAGE

Not applicable.

7. OPERATING MODE

This paragraph is the answer to C/S T007 §5 section d.
The operating mode of the beacon is only an automatic one. This beacon has a homer function (121.5MHz). The switching of the homer depends of the temperature as follow:

- For temperature below 0°C the homer is switch off,
- For temperature above 0°C the homer is switch on.

Regarding current consumption the worst case is at low temperature (-20°C) with the 121.5MHz off, this is mainly due to the increase of battery input resistance at low temperature.

ANNEX B

INTERIM TCXO PROCEDURE

Rev.5

Up Ramp

MTS Characteristic	Time	Temp C°	TOT	OSC	beacon_wc	osc_max	beacon_ max/min	ageing	bcn_ 5 year_max	C/S spec	Pass/ Fail
Residual, ppb	16.82	55.00	1.020E-09	7.902E-11	1.017E-09	2.0E-09	2.244E-09	0.2 E-09	2.444E-09	3.0 E-09	Pass
Static Positive Mean Slope, ppb/min	0.24	-20.0	7.20E-11	-2.037E-10	2.161E-10	7.0E-10	7.326E-10	0	-	1.0 E-09	Pass
Static Negative Mean Slope, ppb/min	0.42	-20.0	-1.01E-10	4.091E-11	-1.090E-10	7.0E-10	-7.084E-10	0	-	-1.0 E-09	Pass
Gradient Positive Mean Slope, ppb/min	1.86	-15.8	4.21E-10	1.808E-10	3.802E-10	1.0E-09	1.070E-09	0	-	2.0 E-09	Pass
Gradient Negative Mean Slope, ppb/min	9.13	20.5	-1.72E-10	-1.597E-11	-1.713E-10	-1.0E-09	-1.015E-09	0	-	-2.0 E-09	Pass

Down Ramp

MTS Characteristic	Time	Temp C°	TOT	OSC	beacon_wc	osc_max	beacon_ max/min	ageing	bcn_ 5 year_max	C/S spec	Pass/ Fail
Residual, ppb	2.36	-13.40	1.060E-09	1.042E-10	1.055E-09	2.0E-09	2.261E-09	0.2 E-09	2.461E-09	3.0 E-09	Pass
Static Positive Mean Slope, ppb/min	1.59	-17.1	2.55E-10	6.879E-13	2.550E-10	7.0E-10	7.450E-10	0	-	1.0 E-09	Pass
Static Negative Mean Slope, ppb/min	17.83	55.0	-1.69E-11	5.787E-11	-6.029E-11	7.0E-10	-7.026E-10	0	-	-1.0 E-09	Pass
Gradient Positive Mean Slope, ppb/min	2.42	-13.0	2.53E-10	-9.175E-11	2.691E-10	1.0E-09	1.036E-09	0	-	2.0 E-09	Pass
Gradient Negative Mean Slope, ppb/min	16.90	55.0	-2.09E-10	-6.216E-11	-1.995E-10	-1.0E-09	-1.020E-09	0	-	-2.0 E-09	Pass