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Report On

Emergency Beacons Limited Testing of the
Jotron AS Tron60 GPS
In accordance with Cospas-Sarsat T.007

Document 75927847 Report 01 Issue 4 May 2015

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REPORT ON

Emergency Beacons Limited Testing of the
Jotron AS
Tron60 GPS

Document 75927847 Report 01 Issue 4

May 2015

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18 May 2015

UKAS TESTING
0141

Product Service

CONTENTS

SECTION 1

REPORT SUMMARY

Emergency Beacons Limited Testing of the
Jotron AS
Tron60 GPS

1.1 INTRODUCTION

The information contained in this report is intended to show verification of the Emergency Beacon Limited Testing of the Jotron AS Tron60 GPS 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	Jotron AS
Model Number(s)	Tron60 GPS
Serial Number(s)	5443 0001
Number of Samples Tested	2
Test Specification/Issue/Date	Cospas-Sarsat T.007 Issue 4 - Rev 8 October 2013
Incoming Release Date	Application Form 29 August 2014
Date of Receipt of Test Samples	13 October 2014
Order Number Date	SL1435001 28 August 2014
Start of Test	13 October 2014
Finish of Test	20 April 2015
Name of Engineer(s)	M Hardy T Guy
Related Documents	Cospas-Sarsat T.001 Issue 3 Revision 14 October 2013

1.2 APPLICATION FORM

Beacon Manufacturer and Beacon Model

Beacon Manufacturer	Jotron AS
Beacon Model	Tron 60GPS
Other Model Names	Simrad EG70

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)		☐

Beacon Characteristics

Characteristic	**Specification**
Operating frequency	406.037MHz
Operating temperature range	Tmin = -20°C Tmax = +55°C
Operating lifetime	48 hours
Beacon power supply type (internal, external, combined, other)	Internal
External power supply parameters (AC/DC and nominal voltage)	
Is external power supply needed to energise the beacon or its ancillary devices in any of operation modes (N/A or Yes of No)	No

Characteristic	Specification
Battery cell chemistry	Lithium/Iron Disulfide (Li/FeS_2)
Battery cell model name, size and number of cells in a battery pack, and details of the battery pack electrical configuration	L91, AA-size, 8 batteries in serial.
Battery cell manufacturer	Energizer
Battery pack manufacturer and part number	Jotron AS, X-83095
Beacon manufacturers declared maximum allowed cell shelf-life (from date of cell manufacture to date of battery pack installation in the beacon)	2 years
Declared beacon battery replacement period (from date of installation in the beacon to expiry date marked on the beacon)	5 years
Oscillator type (e.g. OCXO, MCXO, TCXO)	TCXO
Oscillator manufacturer	Rakon
Oscillator part name and number	E4520LF
Oscillator satisfies long-term frequency stability requirements (Yes or No)	Yes
Antenna type: Integral or Other (e.g. External, Detachable – specify type)	Intergral combined antenna for 406MHz, 121.5MHz and low duty-cycle light at top.
Antenna manufacturer	Shanghai Kewl Imp & Exp Co. LTD, China
Antenna part name and number	Complete antenna, X-83053
Navigation device type (Internal, External or None)	Internal
Features in beacon that prevent degradation to 406 MHz signal or beacon lifetime resulting from a failure of navigation device or failure to acquire position data (Yes, No, or N/A)	Yes
Features in beacon that ensures erroneous position data is not encoded into the beacon message (Yes, No or N/A)	Yes
Navigation device capable of supporting global coverage (Yes, No or N/A)	Yes
Encoded position update capability (Yes, No, N/A)	Yes
Encoded position update interval value (range)	6 minutes
For Internal Navigation Devices	
- Geodetic reference system (WGS 84 or GTRF)	WGS 84
- GNSS receiver cold start forced at every beacon activation (Yes or No)	Yes
- Navigation device manufacturer	uBlox
- Navigation device model name and part Number	MAX-7Q-0
- Internal navigation device antenna type (integrated, internal, external, passive/active), manufacturer and model	Internal passive, Pulse electronics , W3011A
- GNSS system supported (e.g. GPS, GLONASS, Galileo)	GPS/QZSS L1 C/A, GLONASS L1 FDMA, SBAS: WAAS, EGNOS, MSAS

Characteristic	Specification	
For External Navigation Devices		
- Data protocol for GNSS receiver to beacon interface		
- Physical interface for beacon to navigation device		
- Electrical interface for beacon to navigation device		
- Part number of the external navigation interface device (if applicable)		
- Navigation device model and manufacturer (if beacon designed to use specific devices)		
Self-Test Mode Characteristics	Self-Test Mode	Optional GNSS Self-Test Mode
- Activated by a separate switch / separate switch positions (Yes / No)	Yes	No
- Self-test / GNSS self-test mode switch automatically returns to normal position when released (Yes or No)	Yes	Yes
- Self-test / GNSS activation can cause an operational mode transmission (Yes or No)	No	No
- Results in transmission of a single self-test burst only, regardless of how long the self-test activation mechanism is applied (yes or No)	Yes	Yes
- Results of self-test /GNSS self-test indicated by (provide details, e.g Pass /Fail indicator l, strobe light, etc.)	Number of Strobe light flashes. One=OK	Number of Strobe light flashes + audio beep's. Two beep=Pos received, One flash=Selftest OK
- The content of the encoded position data fields of the self-test message has default values	Yes	N/A
- Performs an internal check and indicates that RF power emitted at 406 MHz and 121.5 MHz, if beacon includes a 121.5 MHz homer (Yes or No)	Yes	Yes
- Self-test results in transmission of a signal other than at 406 MHz (Yes & details or No)	Yes, 121.5MHz	Yes, 121.5MHz
- Self-test can be activated directly at beacon (Yes or No)	Yes	Yes
- List of Items checked by self-test	Supported in product manuals	Supported in product manuals
- Self-test / GNS self-test 406 MHz burst duration (440 or 520 ms)	520ms	520ms
- Self-test message length format flag in bit 25,bit ("0" or "1")	1	1
- Maximum duration of a self-test mode, sec	6 sec. if OK and no GNSS test	130s for GNSS and 6s for selftest
- Maximum recommended number of self-tests during battery pack replacement period	N/A	60
- Distinct indication of self-test start (Yes/No)	No	Yes
- Indication of self-test results (Yes/No)	Yes	Yes
- Distinct indication of insufficient battery capacity (Yes or No)	Yes	Yes
- Automatic termination of self-test mode immediately after completion of the self-test cycle (Yes or No)	Yes	Yes
- Maximum number of GNSS Self Tests (beacons with internal navigation devices only)	NA	60
- GNSS Self-test results in transmission of a single burst, irrespectively of the test result (Yes or No)	NA	No
- Maximum number of self-tests during battery pack replacement period	60	N/A
- Self-test / GNSS self-test can be activated from beacon remote activation points (Yes & details or No)	Move and hold switch in TEST position for 15 seconds	Move switch to TEST position twice within 3 seconds, release. Wait for result.
List all methods of self-test mode and GNSS self-test mode activation. Provide details on a separate sheet to describe.	No other methods in addition to the one described above	No other methods in addition to the one described above

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)	X	EPIRB with MMSI
	X	EPIRB with Serial Number
	☐	ELT with 24-bit Address
	☐	ELT with Aircraft Operator Designator
	☐	ELT with Serial Number
	☐	PLB with Serial Number
National Location Protocol (tick where appropriate)	☐	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)	X	Maritime with MMSI
	X	Maritime with Radio Call Sign
	X	EPIRB Float Free with Serial Number
	☐	EPIRB Non Float Free with Serial Number
	X	Radio Call Sign
	☐	Aviation
	☐	ELT with Serial Number
	☐	ELT with Aircraft Operator and Serial Number
	☐	ELT with Aircraft 24-bit Address
	☐	PLB with Serial Number

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

Characteristic	**Specification**
Beacon includes a homer transmitter(s) (Yes or No)	Yes
-Homer transmitter(s) frequency	121.5 MHz
-Homer transmit(s) power	17 dBm ±3dB
-Homer transmitter(s) duty cycle	96 %
-Duty cycle of homer swept tone	37 %
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.	No
Beacon includes automatic activation mechanism (Yes or No) Specify type of automatic beacon activation mechanism	Yes, Sea water contacts
Beacon includes features and functions not listed above, related or non-related to 406 MHz (Yes or No) List features and use a separate sheet if insufficient space	No
Beacon model hardware part number (P/N) and version	X-83082, 1307
Beacon model software/firmware P/N, version, date of issue / releases	X-86740, rel 1.0.11, Sept 17th 2014
Beacon model printed circuit board P/N and version	X-83082, 1307
Beacon Manufacturer Point of Contact (POC) for this Type Approval application:	Name and Job Title: Øyvind Eggen, R&D Manager GMDSS & AIS Phone: +47 3313 9700 E-mail: oyvind.eggen@jotron.com

Dated: 29.08.2014 Signed: Business Unit Certification Manager
(Name, Position and Signature of Beacon Manufacturer Representative)

1.2.1 Information Provided by the Cospas-Sarsat Accepted Test Facility

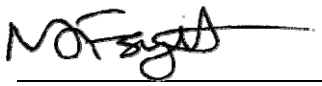
Name and Location of Beacon Test Facility: TÜV SÜD Product Service, United Kingdom

Date of Submission for Testing: October 2014

Applicable C/S Standards:

Document	Issue	Revision	Date
C/S T.001	3	14	Oct-13
C/S T.007	4	8	Oct-13

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).

Signed: 

Name: Nic Forsyth

Position Held: Authorised Signatory

Date: 18 May 2015

1.3 PRODUCT INFORMATION

1.3.1 Technical Description

The Equipment Under Test (EUT) was a Jotron AS Tron60 GPS 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 Satellite Qualitative and Position Accuracy Time and Position Accuracy.

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

1.3.3 Modes of Operation

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

Off/Standby Mode

- Main switch to “READY” position

Self-test

- Main Switch to “TEST” position for 15 seconds
- List of items checked as per Customer Supplied Information (Application Form)
- No navigation data applied

GNSS Self-test

- Main Switch to “TEST” position twice within 3 seconds
- List of items checked as per Customer Supplied Information (Application Form)
- Navigation data applied as applicable (e.g. none applied for timeout, data applied for ‘fast acquisition’)

Operating

- Main switch to “ON” position
- 121 Homer active and offset to 121.6MHz
- GPS operating in normal duty cycle

All modes

All mode descriptions are applicable to all tests unless otherwise stated. Additional methods of activation include:

- Water contacts

Test Modes/Duration

For tests 1 through 7 (as per summary table), the test duration was set to 20 minutes. The GPS receiver duty cycle is as follows: ON for 2 mins, OFF for 6 mins. Excluding a 15 minute warm up from activation, this would give at least three cycles of the GPS receiver duty cycle during the test period.

1.4 MODIFICATIONS

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

1.5 REPORT MODIFICATION RECORD

Issue 1 – First Issue
Issue 2 – Corrections to specification versions in Annex G. Operating Lifetime test and results added to report.
Issue 3 – Draft watermark removed from section 2. SLP and ULP Test Protocol beacon coding software results added. EIRP min / max EOL adjusted with latest operating lifetime result.
Issue 4 –Annex B reference added to contents list.

SECTION 2

TEST DETAILS

Emergency Beacons Limited Testing of the
Jotron AS
Tron60 GPS

TEST RESULTS TABLE

Parameters to be Measured		Range of Specification	Units	Test Results			Comments
				Tmin	Tamb	Tmax	
				(-20°C)	(+21°C)	(+55°C)	
1. Power Output							**Result: Pass**
Model: Tron60 GPS, S/N: 5443, TUV Ref: TSR2 and Modification State 0							
Transmitter power output	(maximum)	35 - 39	dBm	-	37.23*	-	*Power results include 0.36 dB added to the results, due to losses introduced via the 50ohm impedance matching network. Details in Annex A.
	(minimum)			-	37.11*	-	
Power output rise time	(maximum)	< 5	ms	-	0.16	-	
	(minimum)			-	0.13	-	
Power output 1ms before burst	(maximum)	< -10	dBm	-	-33.12	-	
	(minimum)			-	-38.09	-	
2. Digital Message Coding							**Result: Pass**
Model: Tron60 GPS, S/N: 5443, TUV Ref: TSR2 and Modification State 0							
Bit Sync	1 - 15	15 bits “1”	P / F	-	P	-	
Frame sync	16 - 24	“000101111”	P / F	-	P	-	
Format flag	25	1 bit	bit value	-	1	-	
Protocol flag	26	1 bit	bit value	-	0	-	
Identification / position data	27 - 85	59 bits	P / F	-	P	-	
BCH code	86 -106	21 bits	P / F	-	P	-	
Emerg. Code/nat. use/supplem. Data	107 - 112	6 bits	bit value	-	110111	-	
Additional data / BCH (if applicable)	112 - 144	32 bits	P / F	-	P	-	
Position Error (if applicable)		< 5	km	-	N/A	-	

Parameters to be Measured	Range of Specification	Units	Test Results			Comments
			Tmin	Tamb	Tmax	
			(-20°C)	(+21°C)	(+55°C)	
3. Digital Message Generator						**Result: Pass**
Model: Tron60 GPS, S/N: 5443, TUV Ref: TSR2 and Modification State 0						
Repetition rate, T_R:						
Average T_R	48.5 ≤ T_{Ravg} ≤ 51.5	seconds	-	49.351	-	
Minimum T_R	47.5 ≤ T_{Rmin} ≤ 48.0	seconds	-	47.643	-	
Maximum T_R	52.0 ≤ T_{Rmax} ≤ 52.5	seconds	-	52.105	-	
Standard deviation	0.5 - 2.0	seconds	-	1.34	-	
Bit rate						
Minimum fb	≥ 396	bits/sec	-	399.71	-	
Maximum fb	≤ 404	bits/sec	-	399.72	-	
Total transmission time						
Short message (maximum)	435.6 - 444.4	ms	-	N/A	-	
Short message (minimum)			-	N/A	-	
Long message (maximum)	514.8 - 525.2	ms	-	519.82	-	
Long message (minimum)			-	519.77	-	
Unmodulated carrier						
Minimum T1	≥ 158.4	ms	-	160.50	-	
Maximum T1	≤ 161.6	ms	-	160.56	-	
First burst delay	≥ 47.5	seconds	-	58	-	EUT transmits a Self-test burst 8 seconds after activation.

Parameters to be Measured		Range of Specification	Units	Test Results			Comments
				Tmin	Tamb	Tmax	
				(-20°C)	(+21°C)	(+55°C)	
4. Modulation							**Result: Pass**
Model: Tron60 GPS, S/N: 5443, TUV Ref: TSR2 and Modification State 0							
Biphase-L		P / F	P / F	-	P	-	
Rise time	(maximum)	50 - 250	µs	-	146.4	-	
	(minimum)	50 - 250	µs	-	143.3	-	
Fall time	(maximum)	50 - 250	µs	-	146.7	-	
	(minimum)	50 - 250	µs	-	143.7	-	
Phase deviation: positive	(maximum)	+(1.0 to 1.2)	radians	-	1.1388	-	
	(minimum)	+(1.0 to 1.2)	radians	-	1.0351	-	
Phase deviation: negative	(maximum)	-(1.0 to 1.2)	radians	-	-1.1893	-	
	(minimum)	-(1.0 to 1.2)	radians	-	-1.0351	-	
Symmetry measurement		≤ 0.05		-	0.0248	-	
5. 406 MHz Transmitted Frequency							**Result: Pass**
Model: Tron60 GPS, S/N: 5443, TUV Ref: TSR2 and Modification State 0							
Nominal Value	(maximum)	C/S T.001	MHz	-	406.0369523	-	
	(minimum)			-	406.0369520	-	
Short-term stability	(maximum)	≤ $2x10^{-9}$	/100ms	-	39.260E-11	-	
	(minimum)			-	34.731E-11	-	
Medium-term stability – Slope	(maximum)	(-1 to +1)$x10^{-9}$	/minutes	-	85.101E-12	-	
	(minimum)			-	64.260E-12	-	
Medium-term stability – Residual frequency variation	(maximum)	≤ $3x10^{-9}$		-	19.525E-11	-	
	(minimum)			-	17.656E-11	-	
6. Spurious Emissions into 50ohms							**Result: Pass**
Model: Tron60 GPS, S/N: 5443, TUV Ref: TSR2 and Modification State 0							
In band (406.0 – 406.1 MHz)		C/S T.001 mask	P / F	-	P	-	

Parameters to be Measured		Range of Specification	Units	Test Results			Comments
				Tmin	Tamb	Tmax	
				(-20°C)	(+21°C)	(+55°C)	
7. 406 MHz VSWR Check							**Result: Pass**
Model: Tron60 GPS, S/N: 5443, TUV Ref: TSR2 and Modification State 0							
Nominal transmitted frequency		C/S T.001	MHz	-	406.0369520	-	
Modulation rise time	(maximum)	50-250	µs	-	146.4	-	
	(minimum)	50-250	µs	-	143.3	-	
Modulation fall time	(maximum)	50-250	µs	-	146.7	-	
	(minimum)	50-250	µs	-	143.6	-	
Modulation phase deviation: positive	(maximum)	+ (1.0 to 1.2)	radians	-	1.1520	-	
	(minimum)	+ (1.0 to 1.2)	radians	-	1.0336	-	
Modulation phase deviation: negative	(maximum)	- (1.0 to 1.2)	radians	-	-1.1857	-	
	(minimum)	- (1.0 to 1.2)	radians	-	-1.0324	-	
Modulation symmetry measurement		≤ 0.05		-	0.0252	-	
Digital Message		correct	P / F	-	P	-	

Parameters to be Measured	Range of Specification	Units	Test Results			Comments
			Tmin	Tamb	Tmax	
			(-20°C)	(+21°C)	(+55°C)	
8(a). Self-test Mode						**Result: Pass**
Model: Tron60 GPS, S/N: 5443, TUV Ref: TSR2 and Modification State 0						
Frame sync	011010000	P / F	-	P	-	
Format flag	1 / 0	bit value	-	1	-	
Single radiated burst	≤440 / 520 (±1%)	ms	-	519.786	-	
Default position data (if applicable)	correct	P / F	-	P	-	
Description	provided	Y / N	Y			
Design data on protection against repetitive self-test mode transmissions	provided	Y / N	Y			See Annex A
Single burst verification	one burst	P / F	-	P	-	
Provides for 15 Hex ID	correct	P / F	-	P	-	
121.5 MHz RF power (if applicable)	verify that RF power emitted	P / F	-	P	-	
406 MHz power	verify that RF power emitted	P / F	-	P	-	
Distinct indication of Self-Test	provided	Y / N	-	Y	-	A Self-test is initiated by holding the activation switch into the 'TEST' position until the strobe light gives a single flash. No other visual or audio indicators are present.
Distinct indication of RF power being emitted	provided	Y / N	-	Y	-	The manufacturer and Test manual state that RF is transmitted during the Self-test procedure. If this does not occur, the Self-test will fail.
Indication of Self-Test result	provided	Y / N	-	Y	-	The manufacturer's operating manual indicates a single strobe flash as a Self-test PASS. A different number of strobe flashes indicate any errors found during the Self-Test procedure (Indicated in the manufacturer instruction manual).
Maximum duration of Self-Test mode	≤ maximum duration of Self-Test	sec	-	11	-	
Automatic termination of Self-Test mode upon completion of Self-Test and indication of Self-Test results	verify automatic termination	Y / N	-	Y	-	Releasing the switch terminates the test. However, whilst the Self-test procedure terminates automatically, a small current drain (<5 mA) is observed if the activation switch is constantly held in the TEST position. The operator manual advises the user to release the switch after 15 seconds.

Parameters to be Measured	Range of Specification	Units	Test Results			Comments
			Tmin	Tamb	Tmax	
			(-20°C)	(+21°C)	(+55°C)	
8 (b). GNSS Self-Test Mode (if applicable)						**Result: Pass**
Model: Tron60 GPS, S/N: 5443, TUV Ref: TSR2 and Modification State 0						
Frame sync	011010000		-	011010000	-	
Format flag	1 / 0	bit value	-	1	-	
Single radiated burst	≤ 520 (+1%)	ms	-	519.73	-	
Position data (if applicable)	must be within 500m (or 5.25km for User Location Protocol) of the actual position	P / F	-	P	-	
Design data showing how GNSS Self-test is limited in number of transmissions and duration	provided	Y / N	Y			Applicant's data: See Annex A
Single burst verification	one burst	P / F	-	P	-	
121.5 MHz RF power (if applicable)	GNSS self-test checks that RF power is emitted	Y / N	Y			
406 MHz power	GNSS self-test checks that RF power is emitted	Y / N	Y			
Maximum duration of GNSS Self-test	130	s	-	130	-	
Actual duration of Self-test with encoded location	Less than maximum duration	s	-	125	-	
Maximum number of GNSS Self-tests (only beacons with internal navigation devices)	60	Number	-	60	-	
Distinct indication to register successful completion or failure of the GNSS self-test	must be provided	Y/N	-	Y	-	
Distinct indication that a maximum number of GNSS self-tests has been attained after GNSS self-test mode activation and without transmission of a test message of further GNSS receiver current drain	must be provided	Y/N	-	Y	-	

Parameters to be Measured	Range of Specification	Units	Test Results				Comments
10. Operating Lifetime at Minimum Temperature							**Result: Pass**
Model: Tron60 GPS, S/N: 5443, TUV Ref: TSR2 and Modification State 0							
Pre-test battery discharge duration (operating) required		Hours	16.87				
Pre-test battery discharge duration (operating)		Hours	17.0				
Duration	>24	Hours	>80 Hours at Tmin = -20°C				
Effective Operating Lifetime duration	>24	Hours	>80 Hours at Tmin = -20°C				
Transmitted Frequency			Min	Max			Results presented are up to 48 hours, excluding the first 30 minutes.
Nominal value	C/S T.001	MHz	406.0369844	406.036985			
Short-term stability	≤ $2x10^{-9}$	/100ms	5.01E-11	1.56E-10			
Medium-term stability – Slope	(-1 to +1)$x10^{-9}$	/min	-1.19E-10	1.01E-10			
Medium-term stability – Residual frequency variation	≤ $3x10^{-9}$		2.56E-10	6.02E-10			
Transmitter power output	35 - 39	dBm	37.19	37.64			
Digital message	correct	P/F	P				
Homer transmitter continuous operation during the lifetime test		hours	84				
			Start of Test	End of Test			
Homer frequency		MHz	121.5000	121.5000			
Homer peak power level		dBm	16.16	15.77			
Homer transmitter duty cycle		%	97.8	97.8			
14. Satellite Qualitative Tests							**Result: Pass**
Model: Tron60 GPS, S/N: 0001, TUV Ref: TSR1 and Modification State 0							
Test Configuration	As per C/S T.007		Configuration				
			5	6	7	8	
15 Hex ID Decoded by LUT	correct	P / F	P	-	-	-	
Doppler Location results with error ≤ 5km	≥ 80	%	84.6	-	-	-	

Parameters to be Measured	Range of Specification	Units	Test Results	Comments
16. Beacon Coding Software				**Result: Pass**
Model: Tron60 GPS, S/N: 5443, TUV Ref: TSR2 and Modification State 0				
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	

Parameters to be Measured	Range of Specification	Units	Test Results	Comments
17. Navigation System				**Result: Pass**
Model: Tron60 GPS, S/N: 5443, TUV Ref: TSR2 and S/N: 0001, TUV Ref: TSR1 (A.3.8.2.1 and A.3.8.2.2 only) and Modification State 0				
Standard Location protocol	C/S T.001			
A.3.8.1 - Position data default values	correct	P / F	P	
A.3.8.3 - Encoded position data update interval	> 5	min	7.46	
A.3.8.4 - Position clearance after deactivation	cleared	P / F	P	
A.3.8.5 - Position data input update interval (as applicable)	<1.0 min (ELT) <20 min (EPIRB/PLB)	Min	N/A	
A.3.8.6 - Retained last valid position after navigation input lost	240(±5)	min	240.30	
A.3.8.6 - Default position data transmitted after 240(±5) minutes without valid position data	cleared	P / F	P	
A.3.8.7 - Position data encoding	correct	P / F	See Manufacturer supplied Information	See Annex A. Results checked for compliance against Annex D of T.007.
User Location protocol	C/S T.001			
A.3.8.1 - Position data default values	correct	P / F	P	
A.3.8.3 - Encoded position data update interval	> 5	min	6.63	
A.3.8.4 - Position clearance after deactivation	cleared	P / F	P	
A.3.8.5 - Position data input update interval (as applicable)	<1.0 min (ELT) <20 min (EPIRB/PLB)	min	N/A	
A.3.8.6 - Retained last valid position after navigation input lost	240(±5)	min	240.37	
A.3.8.6 - Default position data transmitted after 240(±5)	cleared	P / F	P	

Parameters to be Measured	Range of Specification	Units	Test Results	Comments
minutes without valid position data				
A.3.8.7 - Position data encoding	correct	P / F	See Manufacturer supplied Information	See Annex A. Results checked for compliance against Annex D of T.007.
Standard - Configuration 5				
A.3.8.2.1 - Position accuracy	C/S T.001	m	66.2	
A.3.8.2.1 - Position Acquisition Time	<10/1	min	3.40	
A.3.8.2.2 - Position accuracy	C/S T.001	m	49.8	
A.3.8.2.2 - Position Acquisition Time	<10/1	min	1.67	
User - Configuration 5				
A.3.8.2.1 - Position accuracy	C/S T.001	m	1554.1	
A.3.8.2.1 - Position Acquisition Time	<10/1	min	2.0	
A.3.8.2.2 - Position accuracy	C/S T.001	m	3372.7	
A.3.8.2.2 - Position Acquisition Time	<10/1	min	1.25	
Standard - Configuration 8				
A.3.8.2.1 - Position accuracy	C/S T.001	m	36.7	
A.3.8.2.1 - Position Acquisition Time	<10/1	min	9.46	
A.3.8.2.2 - Position accuracy	C/S T.001	m	49.8	
A.3.8.2.2 - Position Acquisition Time	<10/1	min	2.58	
User - Configuration 8				
A.3.8.2.1 - Position accuracy	C/S T.001	m	1554.1	
A.3.8.2.1 - Position Acquisition Time	<10/1	min	1.0	
A.3.8.2.2 - Position accuracy	C/S T.001	m	3372.7	
A.3.8.2.2 - Position Acquisition Time	<10/1	min	1.0	
Information on protection against beacon degradation due to navigation device, interface or signal failure or malfunction	provided	Y / N	Y	See Annex A

2.1 DIGITAL MESSAGE

2.1.1 Specification

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

2.1.2 Equipment Under Test and Modification State

Tron60 GPS S/N: 5443 - Modification State 0

2.1.3 Date of Test

20 October 2014

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: 21.1 °C
Relative Humidity: 60.9 %

2.1.6 Test Results

Test Duration: 20 minutes
No. of bursts: 27

Ambient Temperature

Full 36 hex message	FFFE2F901E3795437FDFF994C77783E0F66C

ITEM	BITS	VALUE
Message format: long format	25	1
Protocol: Location Protocol	26	0
Country code: 257 - Norway	27-36	0100000001
Type of location protocol: Standard Location - Test	37-40	1110
Test Protocol: Test Protocol (No Decode information in bits 41 to 64)	41-64	001101111001010101000011
Latitude Sign: default	65	0
Latitude Degrees: default	66-72	1111111
Latitude Minutes: default	73-74	11
Longitude Sign: default	75	0
Longitude Degrees: default	76-83	11111111
Longitude Minutes: default	84-85	11

ITEM	BITS	VALUE
BCH 1 Encoded:	86-106	00110010100110001110 1
BCH 1 Calculated:	N/A	00110010100110001110 1
Fixed bits (1101): Pass	107-110	1101
Position Data: Encoded Position Data Source From Internal Navigation Device	111	1
Aux Device: 121.5 MHz homer	112	1
Latitude Offset Sign: default	113	1
Latitude Offset Minutes: default	114-118	00000
Latitude Offset Seconds: default	119-122	1111
Longitude Offset Sign: default	123	1
Longitude Offset Minutes: default	124-128	00000
Longitude Offset Seconds: default	129-132	1111
BCH 2 Encoded:	133-144	011001101100
BCH 2 Calculated:	N/A	011001101100
Composite Latitude: default	N/A	Composite Longitude: default
15 Hex ID:	N/A	203C6F2A86FFBFF

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

Tron60 GPS S/N: 5443 - Modification State 0

2.2.3 Date of Test

20 October 2014

2.2.4 Test Equipment Used

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

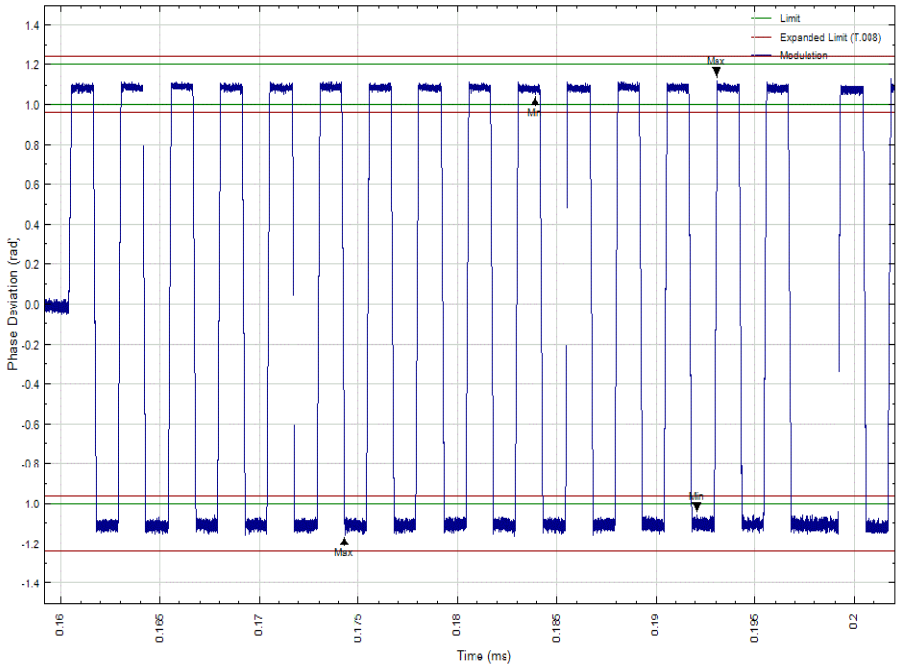
2.2.5 Environmental Conditions

Ambient Temperature: 21.1 °C
Relative Humidity: 60.9 %

2.2.6 Test Results

Test Duration: 20 minutes
No. of bursts: 27

Ambient Temperature



2.3 SPURIOUS EMISSION INTO 50 OHMS

2.3.1 Specification

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

2.3.2 Equipment Under Test and Modification State

Tron60 GPS S/N: 5443 - Modification State 0

2.3.3 Date of Test

21 October 2014

2.3.4 Test Equipment Used

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

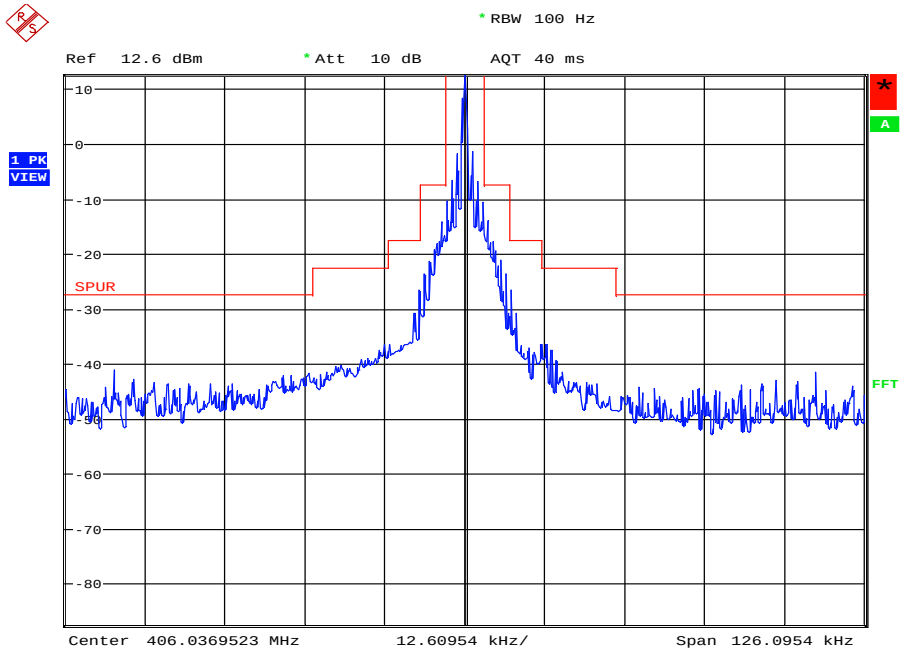
2.3.5 Environmental Conditions

Ambient Temperature: 21.1 °C
Relative Humidity: 47.7 %

2.3.6 Test Results

Test Duration: 20 minutes
No. of bursts: 27

Ambient Temperature



Date: 21.OCT.2014 17:30:51

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

Tron60 GPS S/N: 5443 - Modification State 0

2.4.3 Date of Test

20 October 2014

2.4.4 Test Equipment Used

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

2.4.5 Environmental Conditions

Ambient Temperature: 21.1 °C
Relative Humidity: 60.9 %

2.4.6 Test Results

Test Duration: 20 minutes
No. of bursts: 27

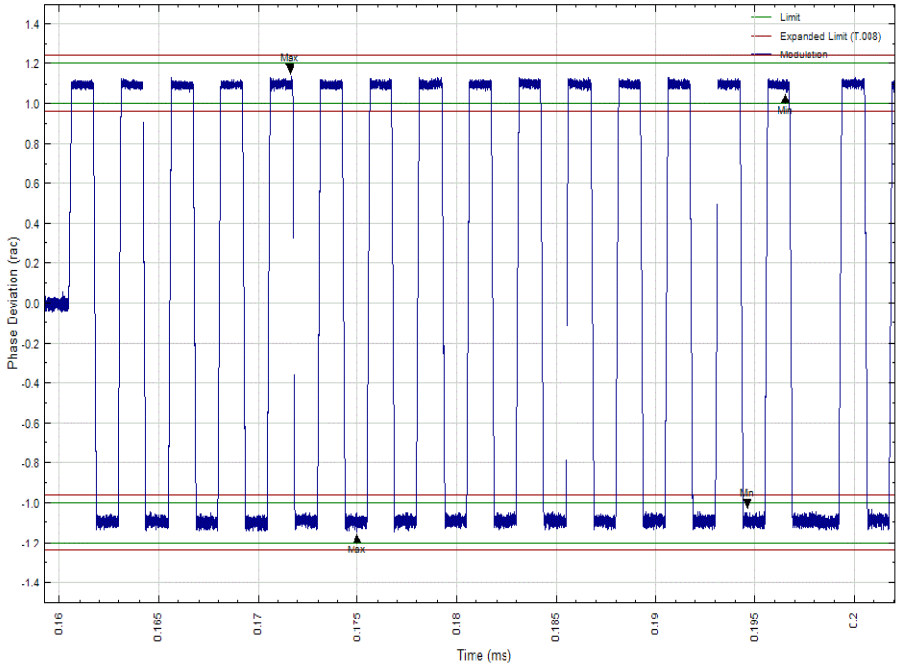
Ambient Temperature

Full 36 hex message	FFFE2F901E3795437FDFF994C77783E0F66C

ITEM	BITS	VALUE
Message format: long format	25	1
Protocol: Location Protocol	26	0
Country code: 257 - Norway	27-36	0100000001
Type of location protocol: Standard Location - Test	37-40	1110
Test Protocol: Test Protocol (No Decode information in bits 41 to 64)	41-64	00110111100101010101000011
Latitude Sign: default	65	0
Latitude Degrees: default	66-72	1111111
Latitude Minutes: default	73-74	11
Longitude Sign: default	75	0
Longitude Degrees: default	76-83	11111111
Longitude Minutes: default	84-85	11

ITEM	BITS	VALUE
BCH 1 Encoded:	86-106	00110010100l100011101
BCH 1 Calculated:	N/A	00110010100l100011101
Fixed bits (1101): Pass	107-110	1101
Position Data: Encoded Position Data Source From Internal Navigation Device	111	1
Aux Device: 121.5 MHz homer	112	1
Latitude Offset Sign: default	113	1
Latitude Offset Minutes: default	114-118	00000
Latitude Offset Seconds: default	119-122	1111
Longitude Offset Sign: default	123	1
Longitude Offset Minutes: default	124-128	00000
Longitude Offset Seconds: default	129-132	1111
BCH 2 Encoded:	133-144	011001101100
BCH 2 Calculated:	N/A	011001101100
Composite Latitude: default	N/A	Composite Longitude: default
15 Hex ID:	N/A	203C6F2A86FFBFF

Modulation Plot



2.5 SELF-TEST MODES

2.5.1 Specification

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

2.5.2 Equipment Under Test and Modification State

Tron60 GPS S/N: 5443 - Modification State 0

2.5.3 Date of Test

21 October 2014 & 22 October 2014

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: 19.9 – 20.5 °C
Relative Humidity: 43.1 – 47.7 %

2.5.6 Test Results

Self-test Mode

- A self-test was initiated by holding the activation switch into the 'TEST' position until the strobe light gave a single flash. The switch had to be released to terminate the test. No other visual or audio indicators were present.

Ambient Temperature

Full 36 hex message	FFFED0901E3795437FDFF994C77783E0F66C

ITEM	BITS	VALUE
Message format: long format	25	1
Protocol: Location Protocol	26	0
Country code: 257 - Norway	27-36	0100000001
Type of location protocol: Standard Location - Test	37-40	1110
Test Protocol: Test Protocol (No Decode information in bits 41 to 64)	41-64	001101111001010101000011
Latitude Sign: default	65	0
Latitude Degrees: default	66-72	1111111
Latitude Minutes: default	73-74	11

ITEM	BITS	VALUE
Longitude Sign: default	75	0
Longitude Degrees: default	76-83	11111111
Longitude Minutes: default	84-85	11
BCH 1 Encoded:	86-106	00110010100l100011101
BCH 1 Calculated:	N/A	00110010100l100011101
Fixed bits (1101): Pass	107-110	1101
Position Data: Encoded Position Data Source From Internal Navigation Device	111	1
Aux Device: 121.5 MHz homer	112	1
Latitude Offset Sign: default	113	1
Latitude Offset Minutes: default	114-118	00000
Latitude Offset Seconds: default	119-122	1111
Longitude Offset Sign: default	123	1
Longitude Offset Minutes: default	124-128	00000
Longitude Offset Seconds: default	129-132	1111
BCH 2 Encoded:	133-144	011001101100
BCH 2 Calculated:	N/A	011001101100
Composite Latitude: default	N/A	Composite Longitude: default
15 Hex ID:	N/A	203C6F2A86FFBFF

GNSS Self-test mode

GNSS self-test with valid position	Actual	Declared
Count	60	60
Maximum Duration (s)	125	130
Indication of GNSS ST activation/completion	• A GNSS self-test activation is indicated by sliding the MAIN switch to the TEST position twice within three seconds. An audible tone sounded every four seconds for the duration of the test. • If navigation data was detected, a double audible tone and strobe light flashed to indicate the end of the test followed by a 406 transmission. • If no navigation data was detected, the audible tone sounded five times to indicate the end of the test. No 406 transmissions were made.	
Indication of counter limit reached	10 x Audible Tone	

With Valid Navigation Input

	Standard Location Protocol		
	-20 °C	+22 °C	+55 °C
Frame sync verification	-	011010000	-
Format Flag (1 bit)	-	1	-
Single Radiated burst (ms)	-	519.78	-
Position data	-	P	-
Single burst verification	-	P	-
Actual duration (sec)	-	35	-
Position Input Latitude	N 51° 22'35”		
Position Input Longitude	W 1° 49'50”		
Position Output Latitude*	-	N 51°22'36”	-
Position Output Longitude*	-	W 1°49'52”	-
Position Error (m)	-	50.1	-

	User Location Protocol		
	-20 °C	+22 °C	+55 °C
Frame sync verification	-	011010000	-
Format Flag (1 bit)	-	1	-
Single Radiated burst (ms)	-	519.73	-
Position data	-	P	-
Single burst verification	-	P	-
Actual duration (sec)	-	37	-
Position Input Latitude	N 51° 22'35”		
Position Input Longitude	W 1° 49'50”		
Position Output Latitude*	-	N 51°24'00”	-
Position Output Longitude*	-	W 1°48'00”	-
Position Error (m)	-	3372.6	-

Without Valid Navigation Input

	Standard Location Protocol		
	-20 °C	+22 °C	+55 °C
Frame sync verification	-	N/A	-
Format Flag (1 bit)	-	N/A	-
Single Radiated burst (ms)	-	N/A	-
Default Position data	-	N/A	-
Single burst verification	-	N/A	-
Actual duration (sec)*	-	125	-

	User Location Protocol		
	-20 °C	+22 °C	+55 °C
Frame sync verification	-	N/A	-
Format Flag (1 bit)	-	N/A	-
Single Radiated burst (ms)	-	N/A	-
Default Position data	-	N/A	-
Single burst verification	-	N/A	-
Actual duration (sec)*	-	125	-

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

All duration measurements were taken from the time the Test switch was activated, to when all apparent activity ceased. No 406 transmissions were made if navigation data was not present.

2.6 OPERATING LIFETIME AT MINIMUM TEMPERATURE

2.6.1 Specification

Cospas-Sarsat T.007, Clause A.2.3

2.6.2 Equipment Under Test and Modification State

Tron60 GPS S/N: 5443 - Modification State 0

2.6.3 Date of Test

15 October 2014 & 29 January to 1 February 2015

2.6.4 Test Equipment Used

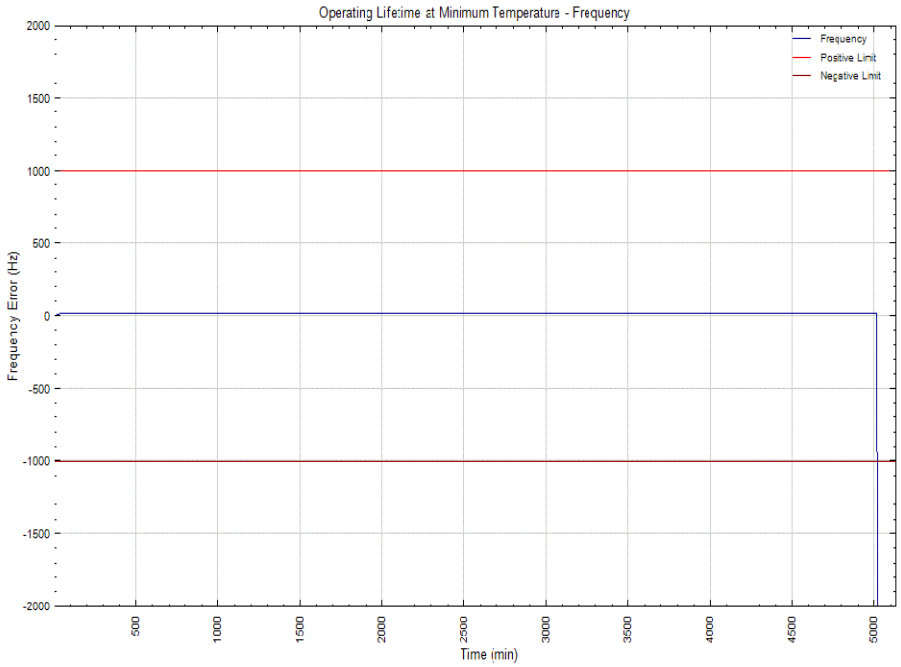
The major items of test equipment used for the above tests are identified in Section 3.1.

2.6.5 Environmental Conditions

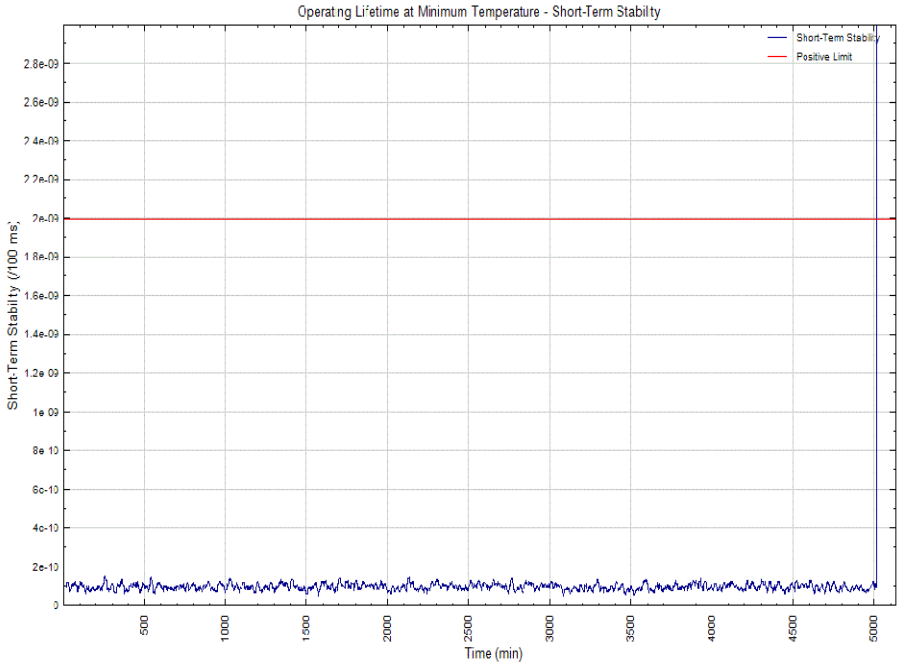
Ambient Temperature 20.0 - 21.7°C
Relative Humidity 23.8 - 69.0%

2.6.6 Test Results

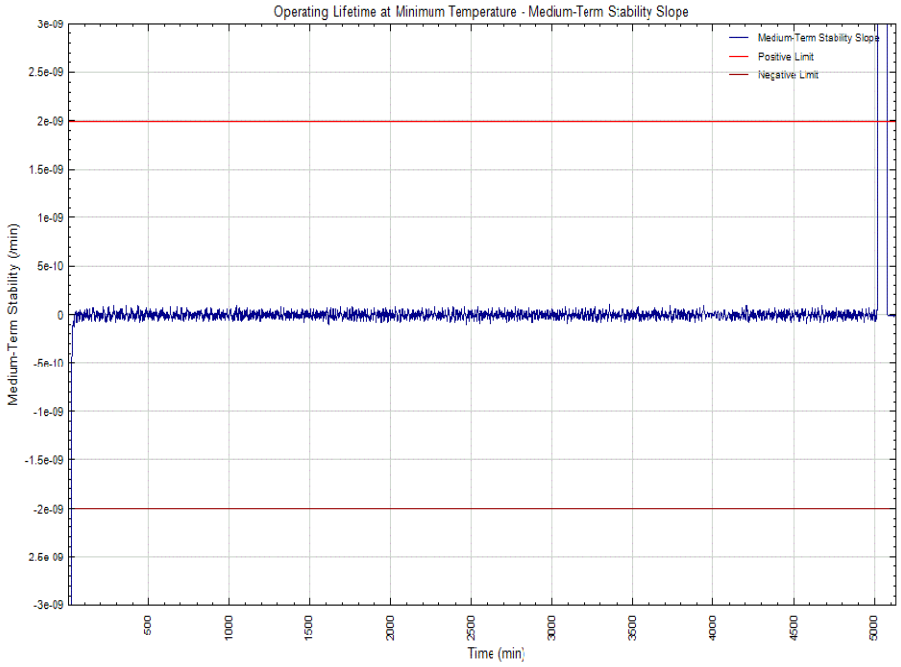
Nominal Frequency



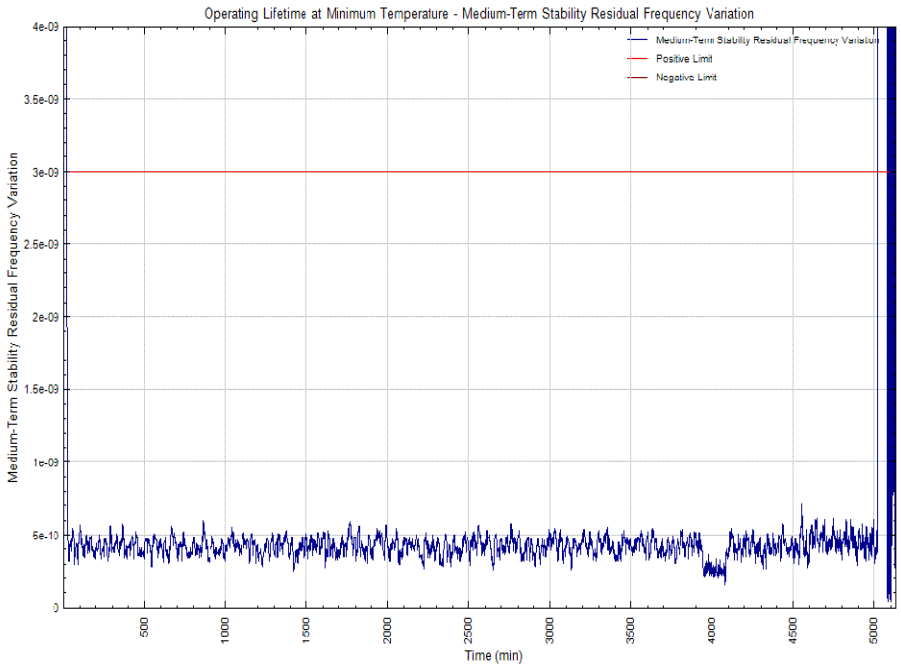
Short Term Stability



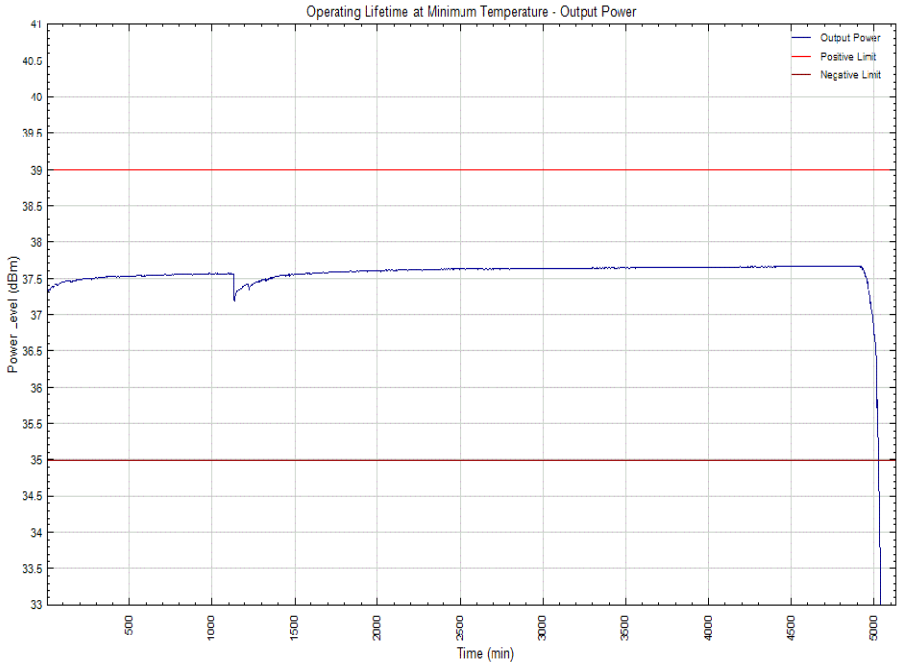
Medium Term Stability, Mean Slope



Medium Term Stability, Residual Frequency Variation



Output Power



Digital Message

Full 36 hex message	FFFE2FD02E18618618668EDB62AFE0FF0146

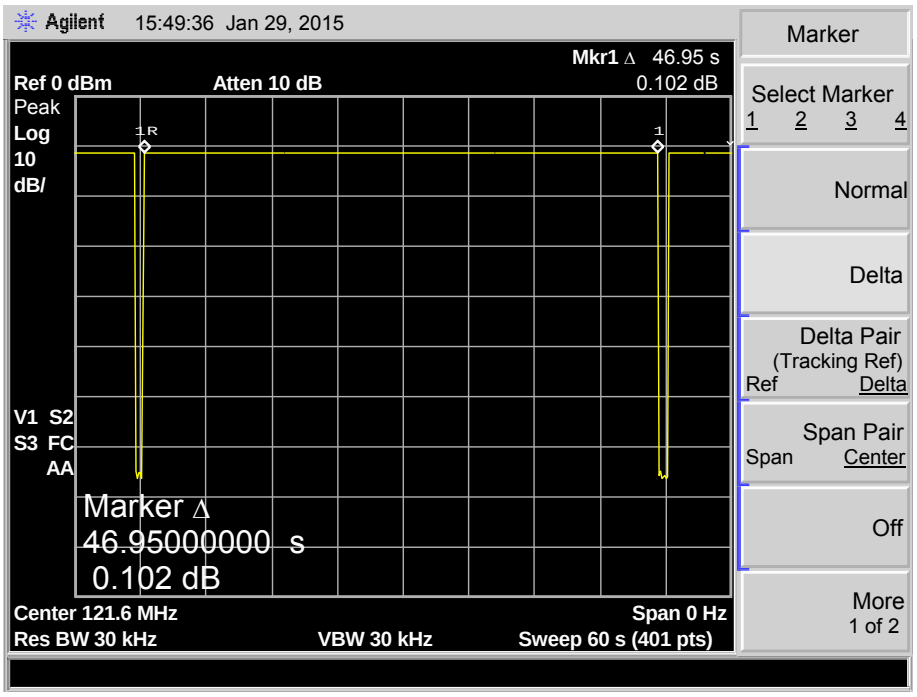
ITEM	BITS	VALUE
Message format: long format	25	1
Protocol: User	26	1
Country code: 258 - **Norway**	27-36	0100000010
User type: Test User	37-39	111
National Use, Hex value: 0C30C30C3347	40-85	0000110000110000110000110000110000110011010001
15 Hex ID:	N/A	A05C30C30C30CD1
Encoded BCH 1:	86-106	11011011011011000101O
Calculated BCH 1:	N/A	11011011011011000101O
Encoded Position Data Source From Internal Navigation Device	107	1
default	108	0
Latitude (degrees): default	109-115	1111111
Latitude (minutes): default	116-119	0000
default	120	0
Longitude (degrees): default	121-128	11111111
Longitude (minutes): default	129-132	0000
Encoded BCH 2:	133-144	000101000110
Calculated BCH 2:	N/A	000101000110
15 Hex ID:	N/A	A05C30C30C30CD1

Test Data (0 min - 30 min)

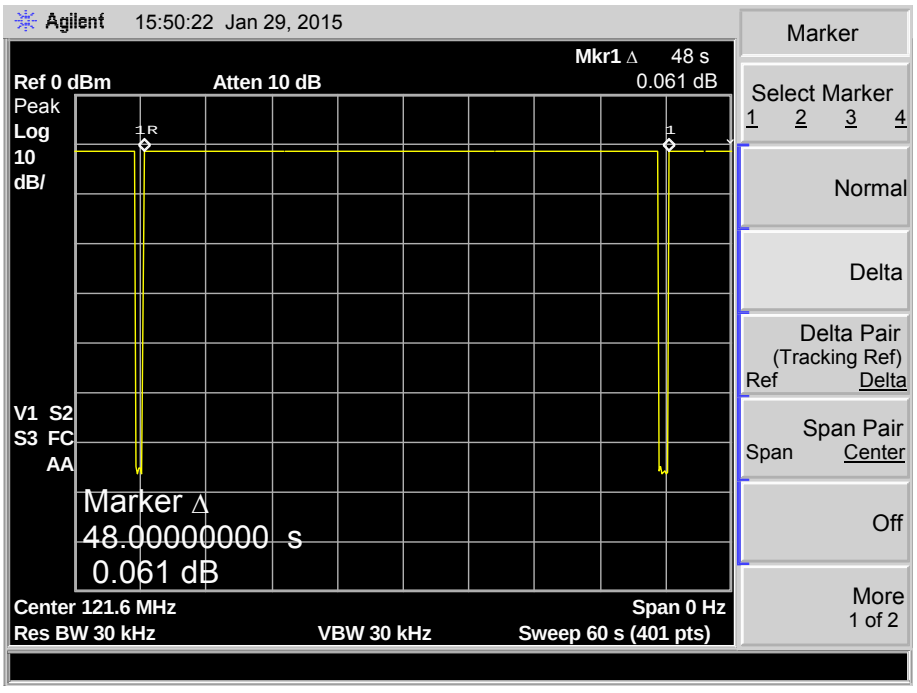
Burst	Power	Frequency	STS	MTS-Slope	MTS-Var	Message	Time
1	37.26	-	-	-	-	FFFE2FD02E18618618668EDB62AFE0FF0146	0
2	37.28	-	-	-	-	FFFE2FD02E18618618668EDB62AFE0FF0146	49.7
3	37.29	-	-	-	-	FFFE2FD02E18618618668EDB62AFE0FF0146	97.6
4	37.3	-	-	-	-	FFFE2FD02E18618618668EDB62AFE0FF0146	147.3
5	37.29	-	-	-	-	FFFE2FD02E18618618668EDB62AFE0FF0146	195.1
6	37.31	-	-	-	-	FFFE2FD02E18618618668EDB62AFE0FF0146	246.5
7	37.31	-	-	-	-	FFFE2FD02E18618618668EDB62AFE0FF0146	296.8
8	37.31	-	-	-	-	FFFE2FD02E18618618668EDB62AFE0FF0146	349.2
9	37.33	-	-	-	-	FFFE2FD02E18618618668EDB62AFE0FF0146	401.3
10	37.36	-	-	-	-	FFFE2FD02E18618618668EDB62AFE0FF0146	451.3
11	37.33	-	-	-	-	FFFE2FD02E18618618668EDB62AFE0FF0146	498.9
12	37.37	-	-	-	-	FFFE2FD02E18618618668EDB62AFE0FF0146	549.6
13	37.34	-	-	-	-	FFFE2FD02E18618618668EDB62AFE0FF0146	599.8
14	37.35	-	-	-	-	FFFE2FD02E18618618668EDB62AFE0FF0146	651.1
15	37.36	-	-	-	-	FFFE2FD02E18618618668EDB62AFE0FF0146	699.3
16	37.36	-	-	-	-	FFFE2FD02E18618618668EDB62AFE0FF0146	750.3
17	37.36	-	-	-	-	FFFE2FD02E18618618668EDB62AFE0FF0146	802.1
18	37.34	406.0369962	9.09E-11	-6.41E-09	1.15E-08	FFFE2FD02E18618618668EDB62AFE0FF0146	854.3
19	37.34	406.0369942	9.39E-11	-5.57E-09	1.19E-08	FFFE2FD02E18618618668EDB62AFE0FF0146	904.8
20	37.34	406.0369925	9.43E-11	-4.72E-09	1.19E-08	FFFE2FD02E18618618668EDB62AFE0FF0146	956.6
21	37.35	406.0369908	9.77E-11	-3.87E-09	1.12E-08	FFFE2FD02E18618618668EDB62AFE0FF0146	1008.9
22	37.36	406.0369894	1.06E-10	-3.01E-09	1.00E-08	FFFE2FD02E18618618668EDB62AFE0FF0146	1057.3
23	37.36	406.0369882	1.10E-10	-2.17E-09	8.27E-09	FFFE2FD02E18618618668EDB62AFE0FF0146	1109.7
24	37.37	406.0369871	1.16E-10	-1.45E-09	6.04E-09	FFFE2FD02E18618618668EDB62AFE0FF0146	1157.5
25	37.37	406.0369864	1.15E-10	-8.70E-10	3.62E-09	FFFE2FD02E18618618668EDB62AFE0FF0146	1205.2
26	37.37	406.0369859	1.18E-10	-5.13E-10	1.94E-09	FFFE2FD02E18618618668EDB62AFE0FF0146	1254
27	37.38	406.0369857	1.17E-10	-3.23E-10	1.22E-09	FFFE2FD02E18618618668EDB62AFE0FF0146	1306.1
28	37.38	406.0369855	1.17E-10	-2.13E-10	7.97E-10	FFFE2FD02E18618618668EDB62AFE0FF0146	1358.5
29	37.38	406.0369854	1.22E-10	-1.49E-10	5.60E-10	FFFE2FD02E18618618668EDB62AFE0FF0146	1406.1
30	37.38	406.0369853	1.18E-10	-1.24E-10	4.67E-10	FFFE2FD02E18618618668EDB62AFE0FF0146	1454.1
31	37.38	406.0369852	1.16E-10	-1.27E-10	4.78E-10	FFFE2FD02E18618618668EDB62AFE0FF0146	1503.1
32	37.39	406.0369852	1.19E-10	-1.12E-10	4.60E-10	FFFE2FD02E18618618668EDB62AFE0FF0146	1553.1
33	37.39	406.0369852	1.14E-10	-1.04E-10	4.59E-10	FFFE2FD02E18618618668EDB62AFE0FF0146	1603.1
34	37.39	406.0369851	1.20E-10	-8.25E-11	4.44E-10	FFFE2FD02E18618618668EDB62AFE0FF0146	1654
35	37.39	406.0369851	1.12E-10	-8.01E-11	4.45E-10	FFFE2FD02E18618618668EDB62AFE0FF0146	1705.1
36	37.39	406.0369851	1.13E-10	-6.21E-11	4.31E-10	FFFE2FD02E18618618668EDB62AFE0FF0146	1757.5

121 Homing Transmitter - Duty Cycle (Start of Test)

On Time



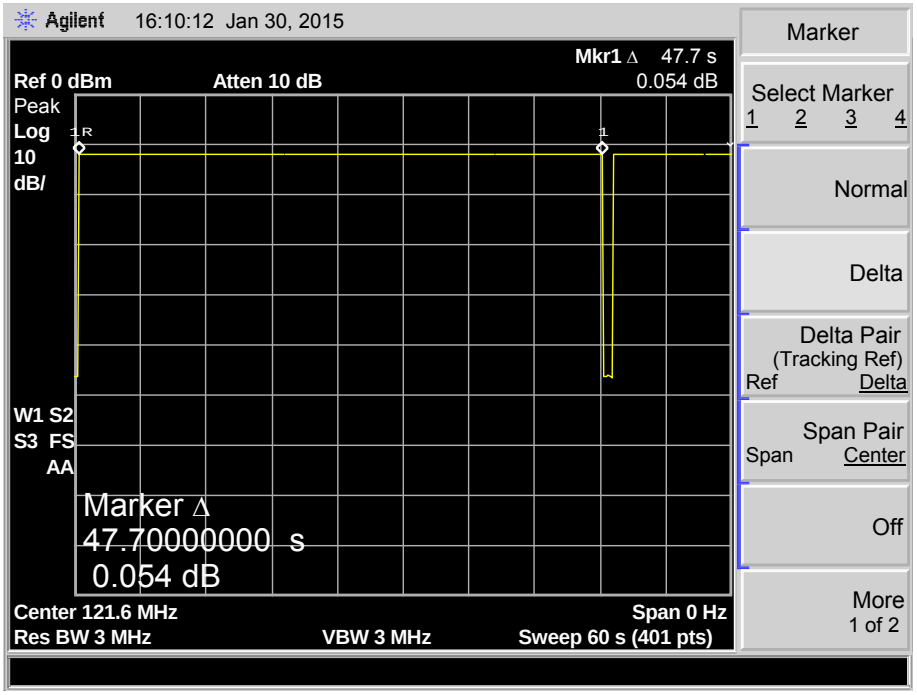
Interval Time



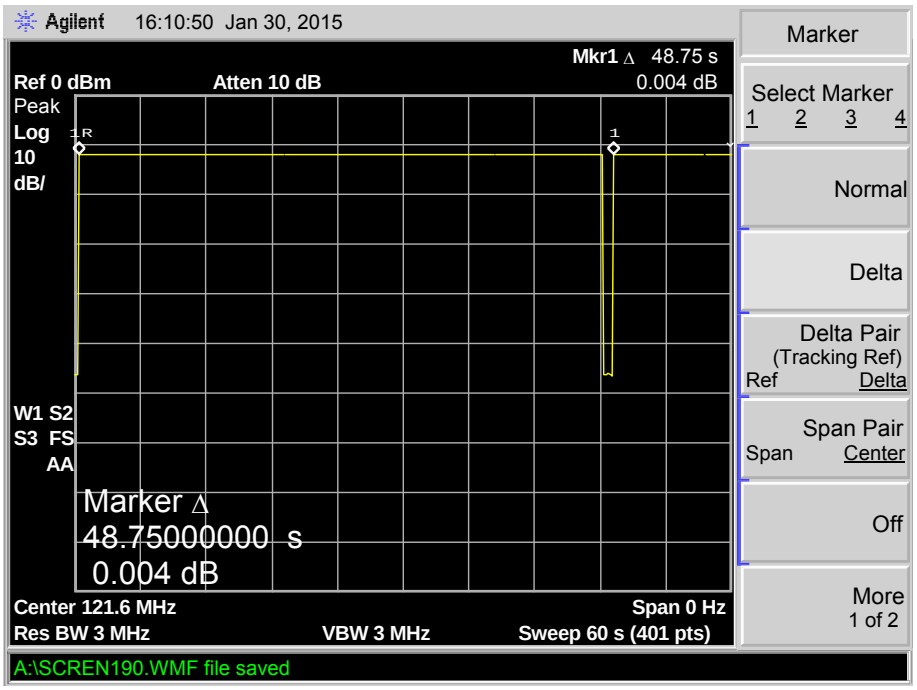
Duty Cycle = 46.95/48*100 = 97.8%

121 Homing Transmitter - Duty Cycle (End of Test – 24 hours)

On Time

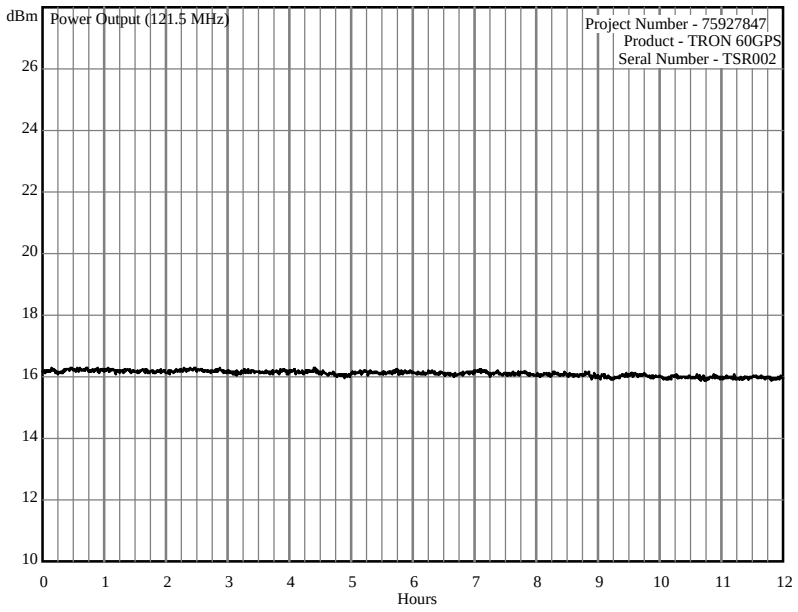


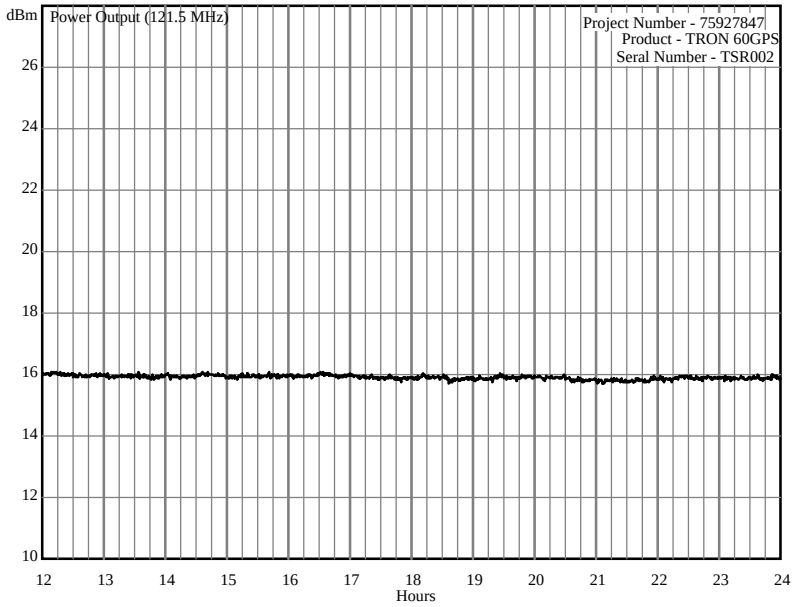
Interval Time

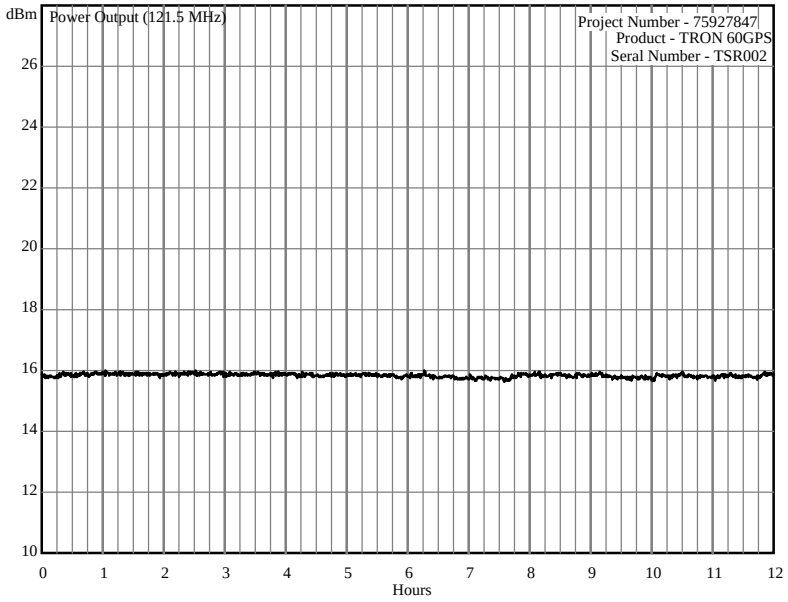


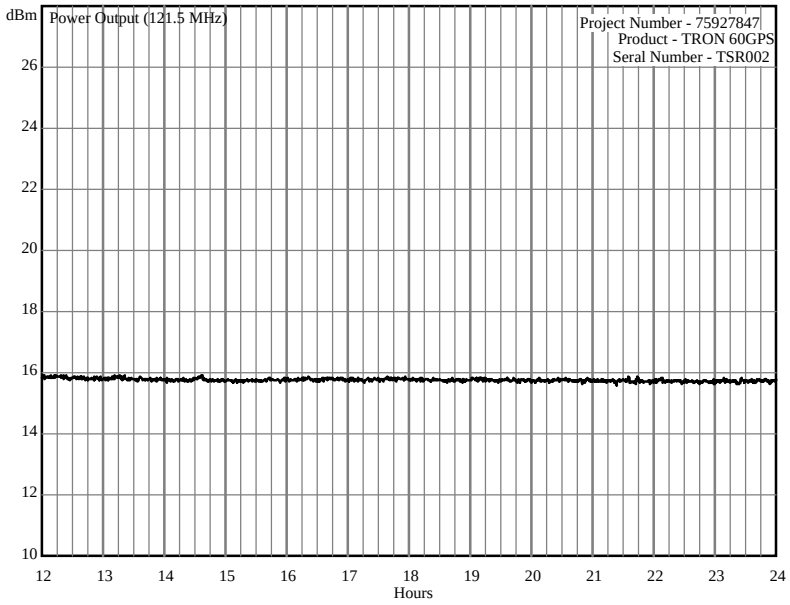
Duty Cycle = 47.7/48.75*100 = 97.8%

121 Homing Transmitter Power (First 48 Hours of Operation)



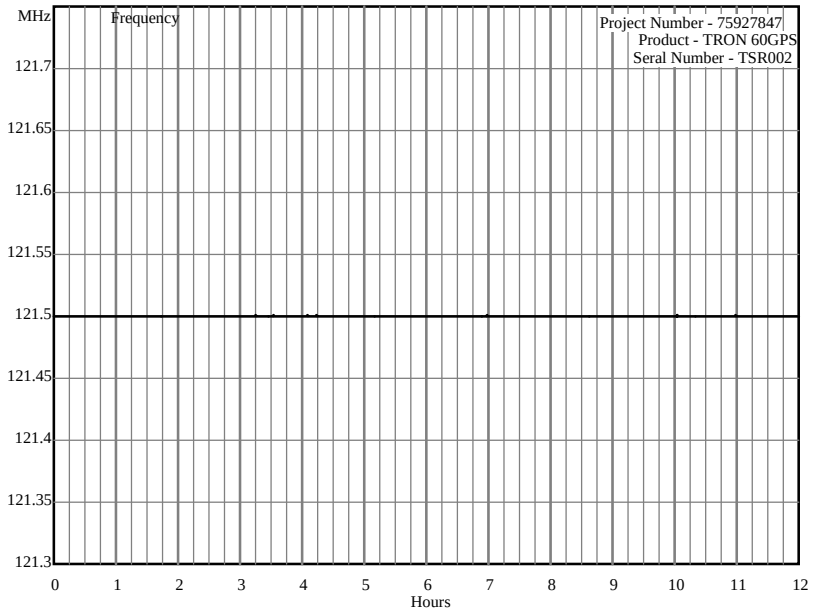


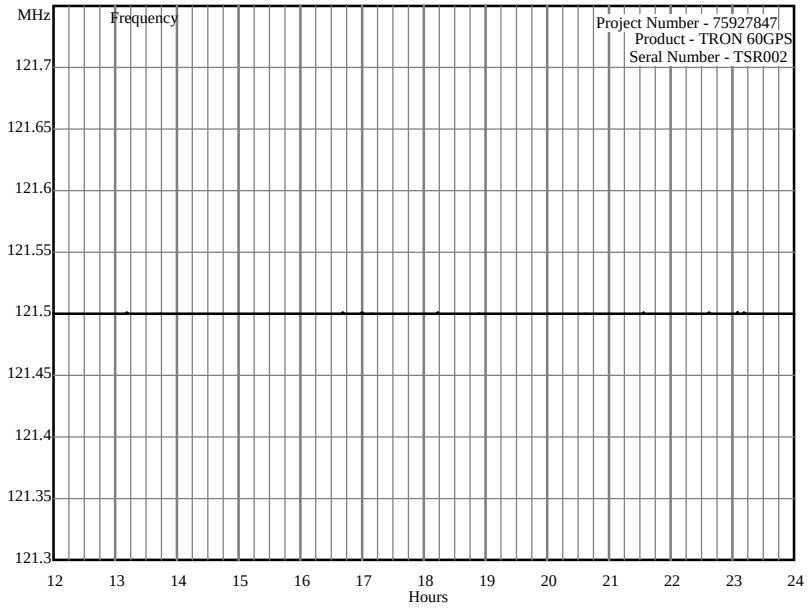


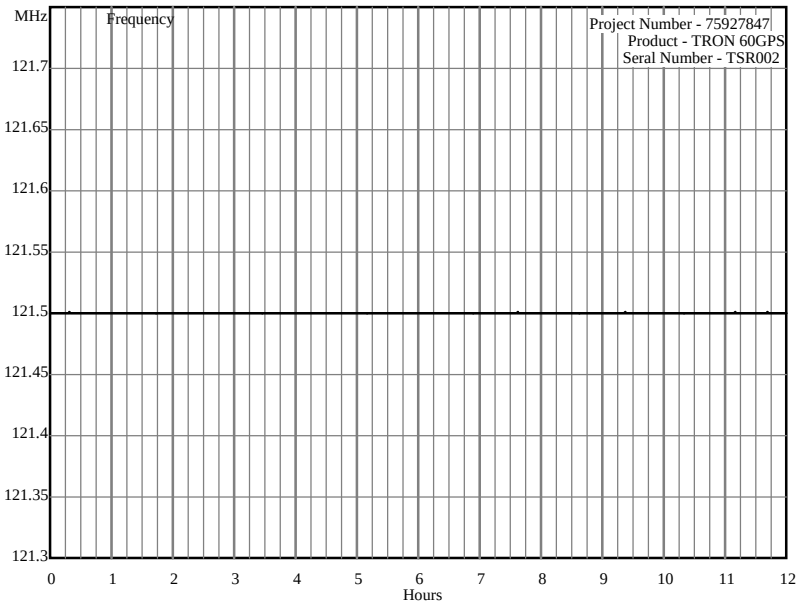


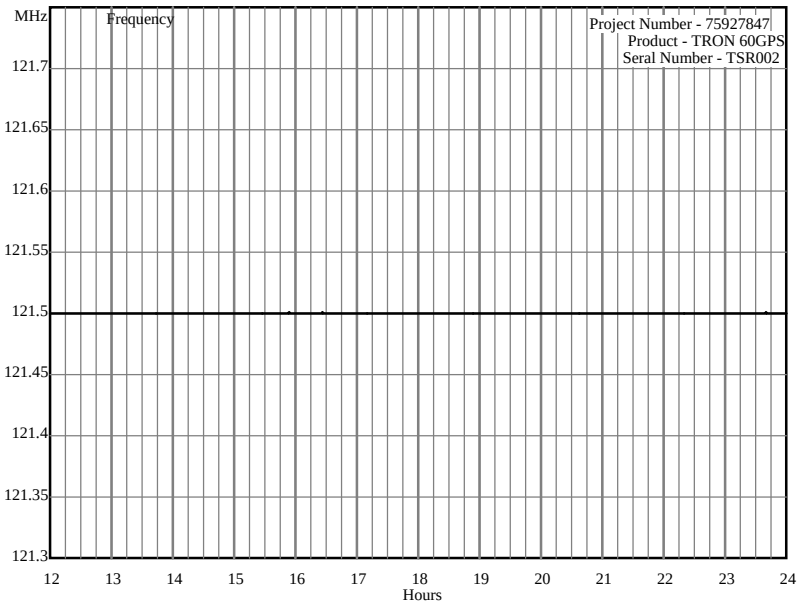
Note: The plots on this page show the output power from 24 to 48 hours. The measurement software resets the measurement time to 0 when it reaches 24 hours.

121 Homing Transmitter Frequency (First 48 Hours of Operation)









Note: The plots on this page show the output frequency from 24 to 48 hours. The measurement software resets the measurement time to 0 when it reaches 24 hours.

Beacon Operating Current

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

Beacon Operating Modes	Mode: Manually selectable or Automatic	Measurement interval, sec	Average Current, mA	Peak Current, mA
A, No Ancillaries - 1, Standby	A	899.9	0.0000	0.0028
B, Float Free bracket - 1, Standby	A	899.9	0.0000	0.0003
A, No Ancillaries - 2, ON at EUT switch*	M	1859	28.14	968.8
B, Float Free bracket - 2, ON at EUT switch**	M	1860	31.14	1077
A, No Ancillaries - 3, ON at Water Contacts	A	1845	30.13	1077
A, No Ancillaries - 4, Self-test	M	15.60	47.84	1016
B, Float Free bracket - 4, Self-test	M	15.52	53.53	1015
A, No Ancillaries - 5, GNSS Self-test Burst	M	40.08	29.07	956.4
A, No Ancillaries - 6, GNSS Self-test Timeout	M	125.8	18.87	20.28

At all times the sampling interval was 80 ms nominal.

The battery current measurements presented are to be compared against those enclosed in Omega Test Report No.11/9 Issue 4 (Dated Dec 14th 2011).

* Configuration used during battery discharge

** Configuration used during Operating Lifetime Test

Battery Discharge Current:

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

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

The individual tests were conducted for the following durations:

Standby Current	:	14.99886667 minutes	(899932 ms)
Self-test Current	:	15.531 seconds	(15531 ms)
GNSS burst Self-test Current	:	40.086 seconds	(40086 ms)
GNSS timeout Self-test Current	:	125.762 seconds	(125762 ms)
Operating Current	:	30.98533333 minutes	(1859120 ms)

Assumptions / Supplied Data:

Battery Replacement Interval	: 12 years	10 Years + 2 Years shelf life
Battery Capacity	: 3.1 Ah	
Battery Self Drain	: 0.70 % per year	
Self-test Interval	: 12 tests per year	
GNSS Self-test Interval	: 6 tests per year	

Test Results:

Mode Current	= Accumulated Charge	/ Time		
Standby Current	= 503498698.4 pC	/ 899932 ms	=	559.49 nA
Self-test Current	= 830807.44 uC	/ 15531 ms	=	53.49 mA
GNSS burst Self-test Current	= 1169468.04 uC	/ 40086 ms	=	29.17 mA
GNSS timeout Self-test Current	= 2373149.2 uC	/ 125762 ms	=	18.87 mA
Operating Current	= 52299426.04 uC	/ 1859120 ms	=	28.13 mA

Battery Preconditioning / Discharge Time Calculations:

Battery Self Drain = Capacity - [(100% - Self Drain/Year%)$^{\text{Replacement Interval}}$ x Capacity]
= 3.1- ((1- 0.0070) ^{12} x 3.1) = 0.2506 Ah

Standby Drain = Hours per year x Battery Replacement Interval x Standby Current
= 365 x 24 x 10 x 559.49 x 10^{-6} = 0.0490 Ah
Worst Case = 1.65 x 0.0490 Ah = 0.0809 Ah

Self-test Drain = Self-tests per battery x Self-test Current x Self-test duration (in hours)
= 12 x 10 x 53.49 x 10^{-3} x (16 / 3600) = 0.0277 Ah
Worst Case = 1.65 x 0.0277 Ah = 0.0457 Ah

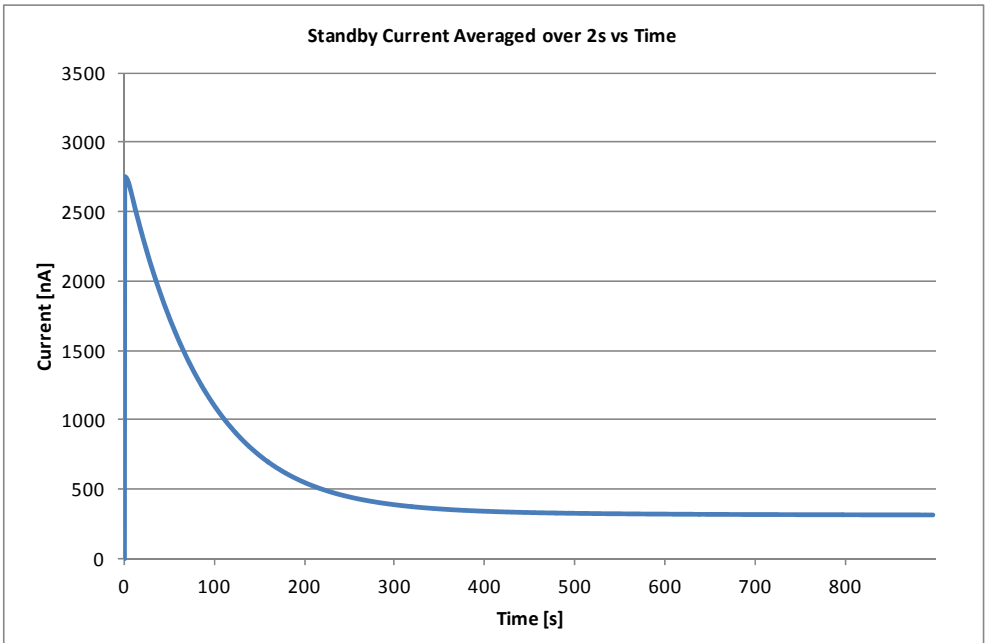
GNSS burst Self-test Drain = Self-tests per battery x Self-test Current x Self-test duration (in hours)
= 6 x 10 x 29.17 x 10^{-3} x (0 / 3600) = 0.0195 Ah
Worst Case = 1.65 x 0.0195 Ah = 0.0322 Ah

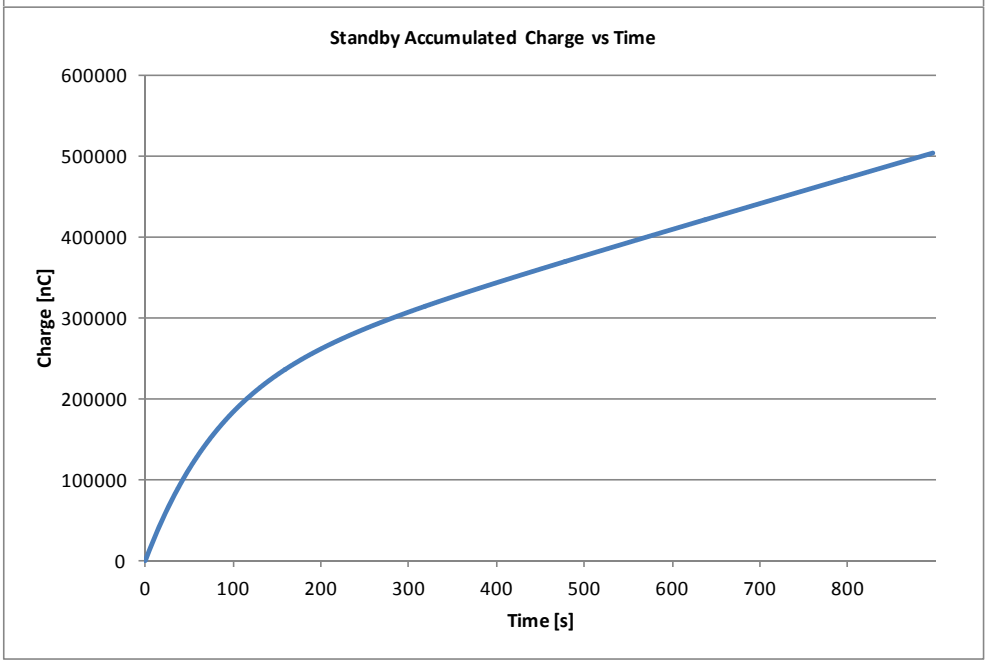
GNSS timeout Self-test Drain = Self-tests per battery x Self-test Current x Self-test duration (in hours)
= 6 x 10 x 18.87 x 10^{-3} x (0 / 3600) = 0.0396 Ah
Worst Case = 1.65 x 0.0396 Ah = 0.0653 Ah

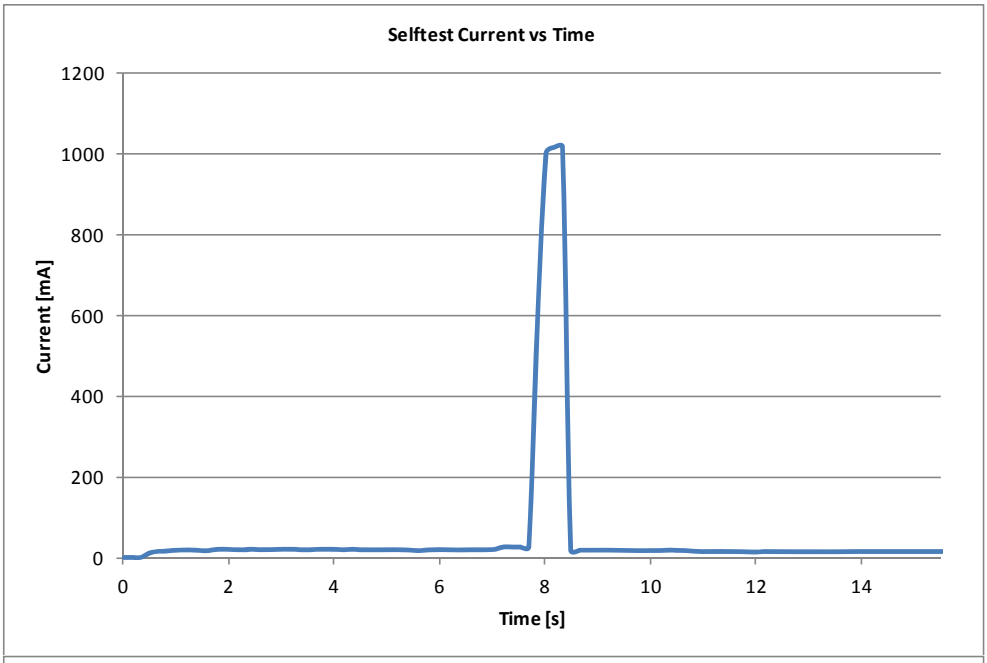
Total Drain = Self Drain + Standby Drain (Worst Case) + Self-test Drain (Worst Case)
+ GNSS burst Self-Test Drain (Worst Case) + GNSS timeout Self-Test Drain (Worst Case)
= 0.2506 + 0.0809 + 0.0457 + 0.0322 + 0.0653 = 0.4746 Ah

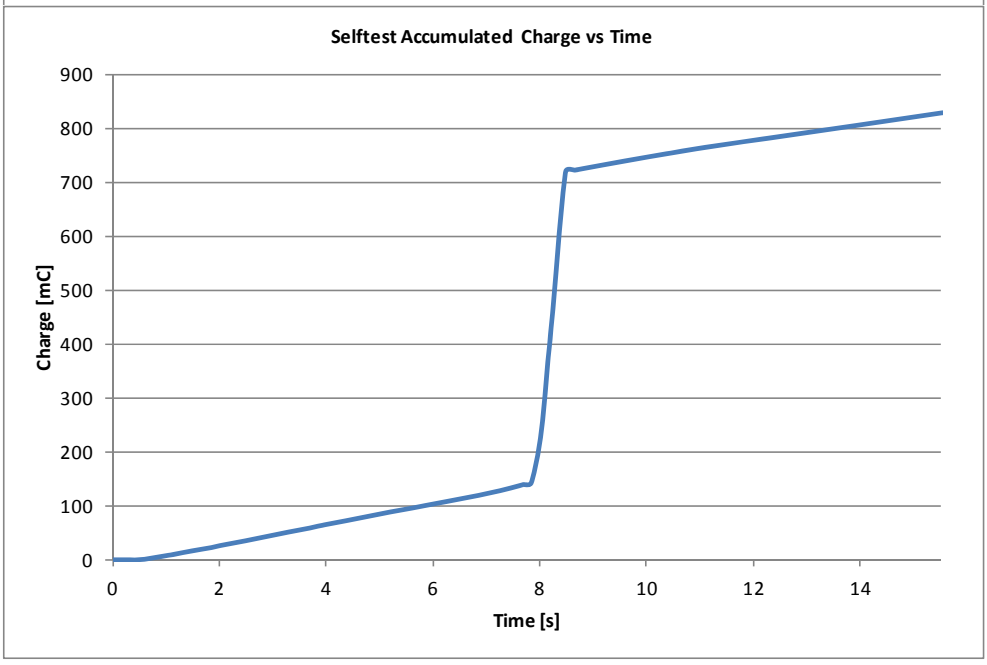
Battery Preconditioning / Discharge Time = Worst Case drain / Operational Current
= 0.4746 / (28.13 x 10^{-3})
= 16.87 hours

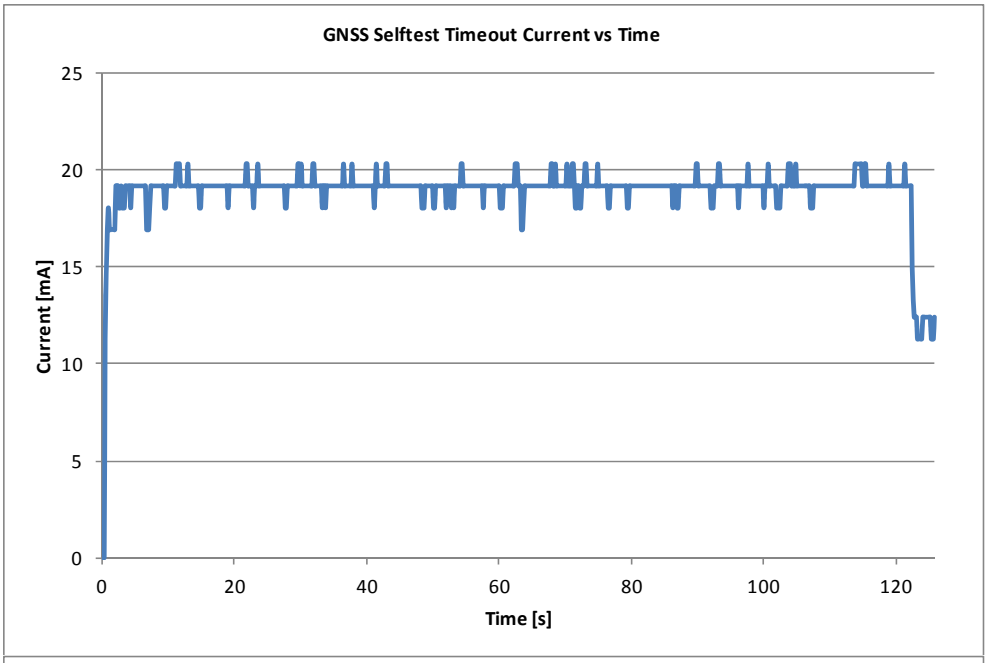
Battery Current Graphs

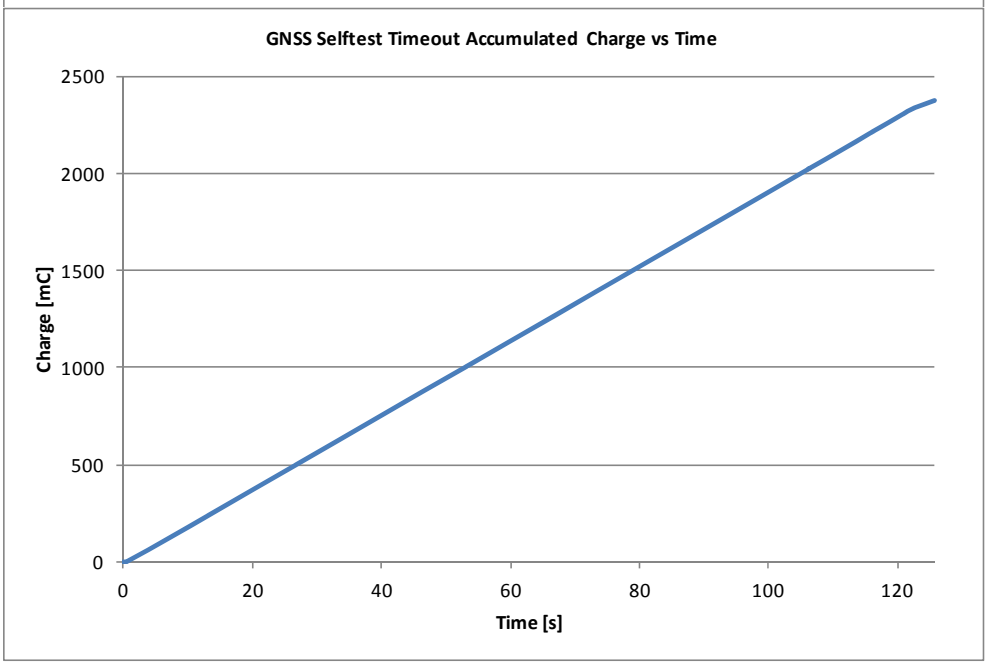


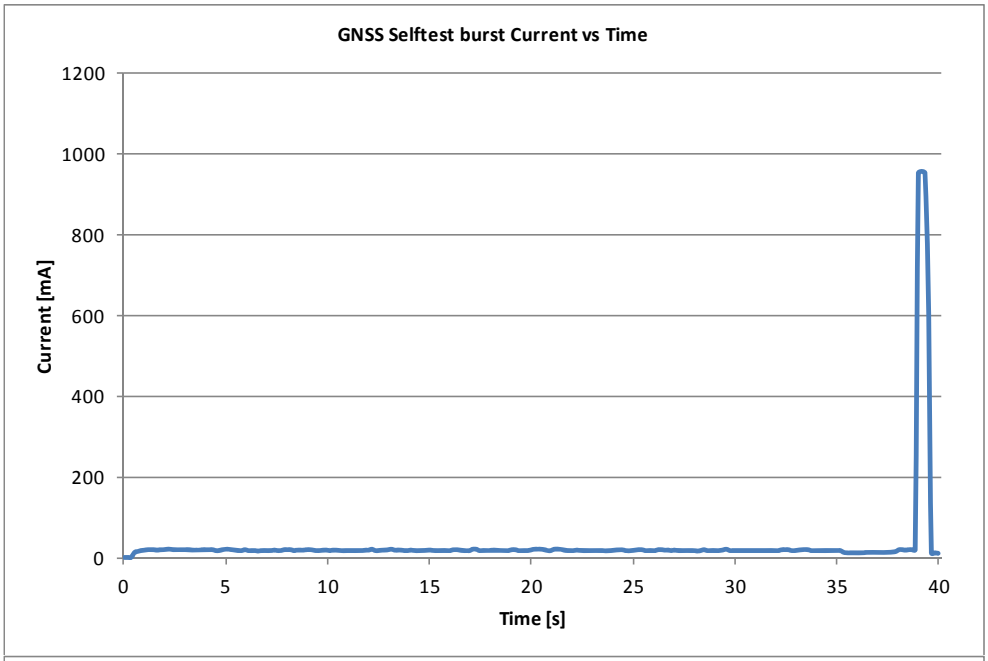


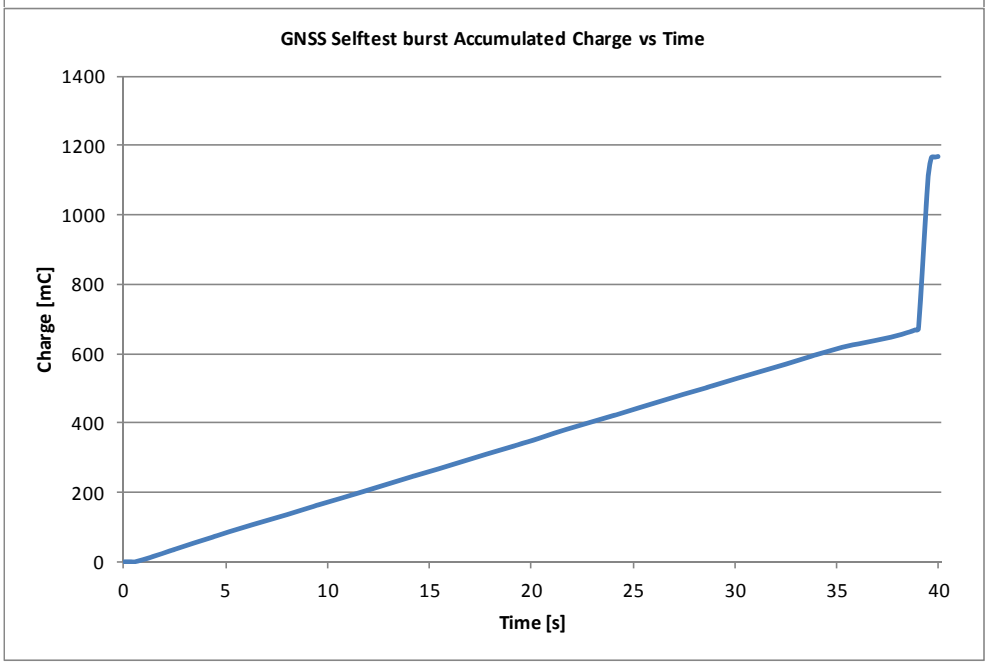

Selftest Current vs Time
1200
1000
800
600
400
200
0
Current [mA]
0
2
4
6
8
10
12
14
Time [s]

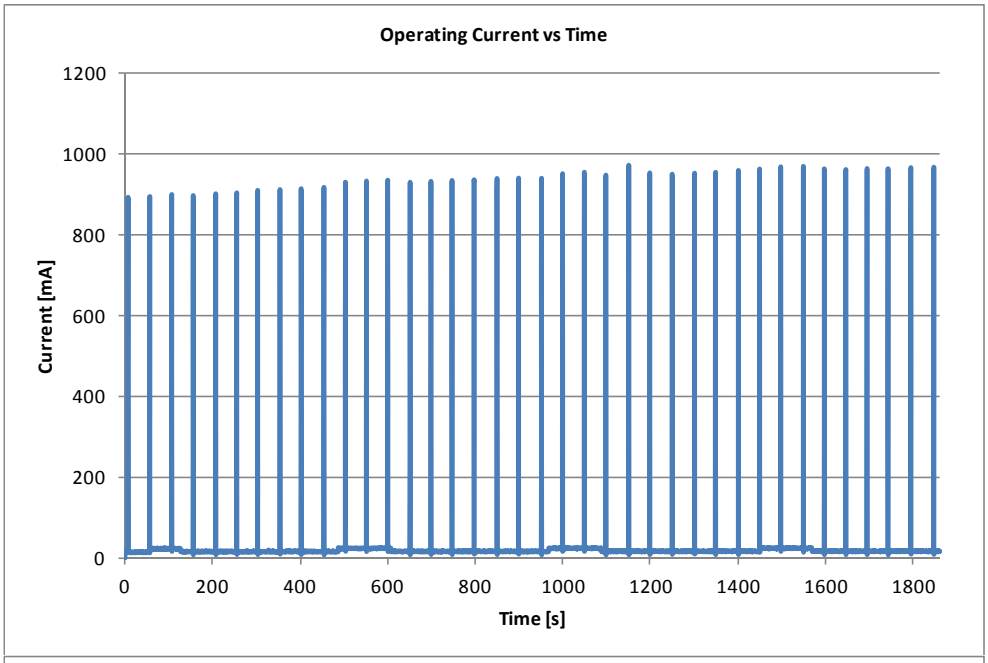

Selftest Accumulated Charge vs Time
900
800
700
600
500
400
300
200
100
0
Charge [mC]
0
2
4
6
8
10
12
14
Time [s]

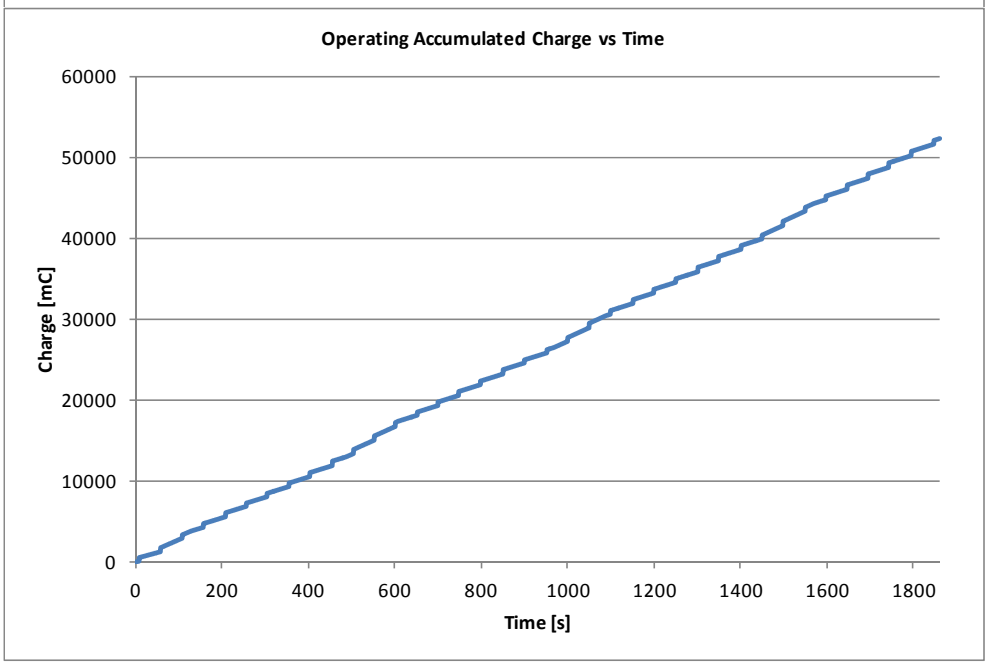

GNSS Selftest Timeout Current vs Time
Current [mA]
25
20
15
10
5
0
0
20
40
60
80
100
120
Time [s]


GNSS Selftest Timeout Accumulated Charge vs Time
Charge [mC]
2500
2000
1500
1000
500
0
0
20
40
60
80
100
120
Time [s]


GNSS Selftest burst Current vs Time
Current [mA]
1200
1000
800
600
400
200
0
0
5
10
15
20
25
30
35
40
Time [s]


GNSS Selftest burst Accumulated Charge vs Time
Charge [mC]
1400
1200
1000
800
600
400
200
0
0
5
10
15
20
25
30
35
40
Time [s]


Operating Current vs Time
Current [mA]
1200
1000
800
600
400
200
0
0
200
400
600
800
1000
1200
1400
1600
1800
Time [s]


Operating Accumulated Charge vs Time
Charge [mC]
60000
50000
40000
30000
20000
10000
0
0
200
400
600
800
1000
1200
1400
1600
1800
Time [s]

2.7 SATELLITE QUALITATIVE TESTS

2.7.1 Specification

Cospas-Sarsat T.007, Clause A.2.5

2.7.2 Equipment Under Test and Modification State

Tron60 GPS S/N: 0001 - Modification State 0

2.7.3 Date of Test

18 October 2014 & 19 October 2014

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: 19.7 – 20.2 °C
Relative Humidity: 67.9 – 78.8 %

2.7.6 Test Results

Configuration 5

Test Start: 18-10-2014 18:12:47
Test End: 19-10-2014 08:13:43
15 Hex ID: A05C30C30C30F71

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

Satellite ID	Satellite Pass Number	15 Hex ID Provided by LUT	Doppler Latitude	Doppler Longitude	Mean Rx Power (dBm)	TCA	CTA (deg)	Location Error (km)
S7	85444	A05C3 0C30C 30F71	50.82936	-1.18574	-130.39	17:19:36	-7.041	1.482
S10	48500	A05C3 0C30C 30F71	50.83291	-1.18174	-135.79	17:54:39	-20.219	1.966
S13	10813	A05C3 0C30C 30F71	50.93560	-1.15489	-136.41	18:36:07	18.856	13.376
S11	41498	A05C3 0C30C 30F71	50.82788	-1.21283	-131.42	19:23:37	12.927	1.519
S13	10814	A05C3 0C30C 30F71	50.83073	-1.20315	-130.07	20:15:00	5.640	1.442
S11	41499	A05C3 0C30C 30F71	50.82704	-1.18413	-128.50	21:03:10	-1.700	1.351
S13	10815	A05C3 0C30C 30F71	50.82334	-1.18921	-136.29	21:55:17	-9.883	0.808
S11	41500	A05C3 0C30C 30F71	50.81986	-1.18918	-132.00	22:44:10	-17.625	0.607
S12	29346	A05C3 0C30C 30F71	50.79685	-1.19711	-136.61	00:44:03	-19.266	2.380
S12	29347	A05C3 0C30C 30F71	50.68170	-1.01099	-126.43	02:25:53	-3.052	20.054
S10	48507	A05C3 0C30C 30F71	50.80913	-1.19961	-128.28	06:10:16	7.954	1.026
S7	85452	A05C3 0C30C 30F71	50.80689	-1.20381	-128.67	07:09:01	10.038	1.340
S10	48508	A05C3 0C30C 30F71	50.80683	-1.20821	-134.54	07:49:32	20.673	1.478

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

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

$$= \frac{11}{13}$$

$$= 84.6\ \%$$

2.8 NAVIGATION SYSTEM TEST

2.8.1 Specification

Cospas-Sarsat T.007, Clause A.2.7

2.8.2 Equipment Under Test and Modification State

Tron60 GPS S/N: 5443 - Modification State 0

2.8.3 Date of Test

15 October 2014, 17 October 2014 & 21 October 2014

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: 17.8 – 21.2 °C
Relative Humidity: 44.6 – 70.1 %

2.8.6 Test Results

Standard Protocol

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

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

36 Hex Message	Message Count
FFFE2F901E3795437FDFF994C77783E0F66C	36

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

Locations:

A.3.8.2.1:	N 50° 52.121’	W 1° 14.685’	①
A.3.8.2.2:	N 51° 22.583’	W 1° 49.833’	②

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

Configuration as per C/S T.007	C/S T.007 Section A.3.8.2.1		C/S T.007 Section A.3.8.2.2	
	Time to Acquire Position (min)	Location Error in metres	Time to Acquire Position (min)	Location Error in metres
Configuration 5	3.40	66.2	1.67	49.8
Configuration 8	9.46	36.7	2.58	49.8

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

① GPS Site Survey – Live Location
② Input from GPS simulator

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

Location: N 51° 22.583’ W 1° 49.833’ ①		
Data Acquired at	15:36:19	FFFE2F901E37954333A03F63B4B71DA4D4D0
Location: N 50° 48.683’ W 1° 37.417’ ①		
Data Updated at	15:43:47	FFFE2F901E37954332E030B715B78EA76951
Data Update Interval	7 min 28 s	

① Input from GPS simulator

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

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

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

Location: N 51° 22.583' W 1° 49.833' ①		
Data Acquired at	9:39:24	FFFE2F901E37954333A03F63B4B71DA4D4D0
GPS Signal Navigation Data Removed		
Data Updated at	13:39:42	FFFE2F901E3795437FDFF994C77783E0F66C
Last Valid Position Held	240min 18s	
Return to Default Position	✓	

① Input from GPS simulator

User Protocol

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

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

36 Hex Message	Message Count
FFFE2FD02E18618618668EDB62AFE0FF0146	37

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

Locations:

A.3.8.2.1:	N 50° 52.121’	W 1° 14.685’	①
A.3.8.2.2:	N 51° 22.583’	W 1° 49.833’	②

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

Configuration as per C/S T.007	C/S T.007 Section A.3.8.2.1		C/S T.007 Section A.3.8.2.2	
	Time to Acquire Position (sec)	Location Error in metres	Time to Acquire Position (sec)	Location Error in metres
Configuration 5	120	1554.1	75	3372.7
Configuration 8	60	1554.1	60	3372.7

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

① GPS Site Survey – Live Location
② Input from GPS simulator

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

Location: N 51° 22.583’ W 1° 49.833’ ①		
Data Acquired at	10:02:35	FFFE2FD02E18618618668EDB62A66D01C026
Location: N 50° 48.683’ W 1° 37.417’ ①		
Data Updated at	10:09:13	FFFE2FD02E18618618668EDB62A65901967F
Data Update Interval	6 min 38 s	

① Input from GPS simulator

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

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

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

Location: N 51° 22.583' W 1° 49.833' ①		
Data Acquired at	10:16:59	FFFE2FD02E18618618668EDB62A66D01C026
GPS Signal Navigation Data Removed		
Data Updated at	14:17:21	FFFE2FD02E18618618668EDB62AFE0FF0146
Last Valid Position Held	240 min 22s	
Return to Default Position	✓	

① Input from GPS simulator

2.9 BEACON CODING SOFTWARE

2.9.1 Specification

Cospas-Sarsat T.007, Clause A.2.8

2.9.2 Equipment Under Test and Modification State

Tron60 GPS S/N: 0001 - Modification State 0

2.9.3 Date of Test

12 February 2015 & 20 April 2015

2.9.4 Test Equipment Used

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

2.9.5 Environmental Conditions

Ambient Temperature 22.6°C
Relative Humidity 29.1%

2.9.6 Test Results

Protocol	Operational Message		Self-Test Message	GNSS Self Test Message
	Location A	Location B		Location A
Standard Location: EPIRB with MMSI	FFFE2F8C92F423F133A03FFACBF71DA4D4D0	FFFE2F8C92F423F132E0302E6AF78EA76951	FFFED08C92F423F17FDFF90DB83783E0F66C	FFFED08C92F423F133A03FFACBF71DA4D4D0
Standard Location: EPIRB with Serial Number	FFFE2F8C9637806333A038517D371DA4D4D0	FFFE2F8C9637806332E03785DC378EA76951	FFFED08C963780637FDFFEA60EF783E0F66C	FFFED08C9637806333A038517D371DA4D4D0
Standard Location: Test	FFFE2F8C9E37800133A03CE7D4F71DA4D4D0	FFFE2F8C9E37800132E0333375F78EA76951	FFFED08C9E3780017FDFFA10A73783E0F66C	FFFED08C9E37800133A03CE7D4F71DA4D4D0
User Location: Maritime with MMSI	FFFE2FCC94186186186E88D48FE66D01C026	FFFE2FCC94186186186E88D48FE65901967F	FFFED0CC94186186186E88D48FEFE0FF0146	FFFED0CC94186186186E88D48FE66D01C026
User Location: Maritime with Radio Call Sign	FFFE2FCC9526F6F06B2E8E95EF666D01C026	FFFE2FCC9526F6F06B2E8E95EF665901967F	FFFED0CC9526F6F06B2E8E95EF6FE0FF0146	FFFED0CC9526F6F06B2E8E95EF666D01C026
User Location: EPIRB Float Free with Serial Number	FFFE2FCC96A000C6001BCC7F0B666D01C026	FFFE2FCC96A000C6001BCC7F0B665901967F	FFFED0CC96A000C6001BCC7F0B6FE0FF0146	FFFED0CC96A000C6001BCC7F0B666D01C026
User Location: Radio Call Sign	FFFE2FCC9DBDBC1A554ECBD695A66D01C026	FFFE2FCC9DBDBC1A554ECBD695A65901967F	FFFED0CC9DBDBC1A554ECBD695AFE0FF0146	FFFED0CC9DBDBC1A554ECBD695A66D01C026
User Location: Test	FFFE2FCC9E186186186E8DCBB7A66D01C026	FFFE2FCC9E186186186E8DCBB7A65901967F	FFFED0CC9E186186186E8DCBB7AFE0FF0146	FFFED0CC9E186186186E8DCBB7A66D01C026

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, 2.5 Beacons - Constant Temperature Tests					
Power Meter	Hewlett Packard	436A	83	12	29-Aug-2015
Signal Generator	Hewlett Packard	8644A	199	12	14-Apr-2015
Hygromer	Rotronic	Hygropalm	2404	12	22-May-2015
Distress Beacon RF Unit	TUV SUD Product Service	-	2445	-	TU
Stop Clock	R.S Components	RS328 061	2674	12	30-Jun-2015
Termination (50ohm, 2W)	Omni-Spectra	3001-6100	3081	12	27-Mar-2015
GPS/SBAS Simulator	Spirent	STR4500	3056	-	TU
Attenuator (20dB, 10W)	Aeroflex / Weinschel	23-20-34	3158	12	30-Jun-2015
Attenuator (3dB, 20W)	Aeroflex / Weinschel	23-03-34	3163	12	16-Sep-2015
Bandpass Filter	Trilithic	5BE406/35-1-AA	3205	12	17-Sep-2015
Time Interval Analyser	Yokogawa	TA720 704510	3253	12	19-Nov-2014
Power Sensor	Agilent Technologies	8482A	3289	12	14-Jan-2015
ESA-E Series Spectrum Analyser	Agilent Technologies	E4402B	3348	12	5-Sep-2015
Cable (1m, N Type)	Rhophase	NPS-1601-1000-NPS	3353	12	29-Apr-2015
Cable (1m, N Type)	Rhophase	NPS-1601-1000-NPS	3354	12	29-Apr-2015
Cable (2m, N Type)	Rhophase	NPS-1601-2000-NPS	3358	12	3-Dec-2014
Rubidium Frequency Standard	Symmetricom	8040C	3490	12	31-Mar-2015
ScopeCorder	Yokogawa	DL750	4175	12	29-Jan-2015
GPS Antenna	ACC	PA175-S	4228	-	TU
Section 2.3 Beacons - Spurious Emissions					
Hygromer	Rotronic	Hygropalm	2404	12	22-May-2015
Attenuator (20dB, 10W)	Aeroflex / Weinschel	23-20-34	3158	12	30-Jun-2015
Attenuator (3dB, 20W)	Aeroflex / Weinschel	23-03-34	3163	12	16-Sep-2015
Cable (1m, N Type)	Rhophase	NPS-1601-1000-NPS	3353	12	29-Apr-2015
Rubidium Frequency Standard	Symmetricom	8040C	3490	12	31-Mar-2015
Signal Analyser	Rohde & Schwarz	FSQ 26	3545	12	6-Aug-2015
Section 2.6 Beacons - Battery Current Measurements					
Hygromer	Rotronic	Hygropalm	2404	12	22-May-2015
Termination (50ohm, 15W)	Diamond Antenna	DL-30N	3096	12	5-Mar-2015
8 Channel Datalogger + Terminal Board	Pico Technology Ltd	ADC-16	3287	12	12-Dec-2014
Resistor (Nominal 0.25ohm)	TUV SUD Product Service	2x RS Components 188-071 R5/100W Resistors	3343	12	25-Oct-2014
Section 2.7 Beacons - Satellite Qualitative Test					
Beacon Tester	WS Technologies	BT 100S	87	-	TU
Hygromer	Rotronic	Hygropalm	2404	12	22-May-2015
Humidity & Temperature Meter	Radio Spares	1361C	4420	12	1-May-2015
Section 2.8 Beacons - Navigation System					
Beacon Tester	WS Technologies	BT 100S	87	-	TU
Hygromer	Rotronic	Hygropalm	2404	12	22-May-2015
Stop Clock	R.S Components	RS328 061	2674	12	30-Jun-2015
GPS/SBAS Simulator	Spirent	STR4500	3056	-	TU
Copper GRP	TUV SUD Product Service	27cm Diameter	3538	-	TU
GPS Antenna	ACC	PA175-S	4228	-	TU
Section 2.9 Beacons – Beacon Coding Software					
Beacon Tester	WS Technologies	BT 100S	87	-	TU
Hygromer	Rotronic	Hygropalm	2404	12	22-May-2015
GPS/SBAS Simulator	Spirent	STR4500	3056	-	TU

Section 2.6 Beacons - Operating Lifetime					
Climatic Chamber	Heraeus Votsch	VMT 04/30	40	-	O/P Mon
Power Meter	Hewlett Packard	436A	83	12	29-Aug-2015
Rubidium Frequency Standard	Quartzlock	A10-B	92	12	30-Jan-2015
Signal Generator	Hewlett Packard	8644A	96	12	23-Apr-2015
Attenuator: 10dB/20W	Narda	766-10	480	12	3-Dec-2015
Broadband Resistive Power Divider	Weinschel	1506A	601	12	21-Mar-2015
Attenuator (10dB, 10W)	Trilithic	HFP-50N	1377	12	22-Oct-2015
Distress Beacon RF Unit	TUV SUD Product Service	-	2445	-	TU
Termination (50ohm, 2W)	Omni-Spectra	3001-6100	3081	12	27-Mar-2015
Attenuator (3dB, 20W)	Aeroflex / Weinschel	23-03-34	3162	12	18-Nov-2015
Attenuator (3dB, 20W)	Aeroflex / Weinschel	23-03-34	3163	12	16-Sep-2015
Thermocouple Thermometer	Fluke	51	3172	12	24-Sep-2015
Bandpass Filter	Trilithic	5BE406/35-1-AA	3205	12	17-Sep-2015
Time Interval Analyser	Yokogawa	TA720 704510	3253	12	11-Nov-2015
ScopeCorder	Yokogawa	DL750 701210	3254	12	10-Nov-2015
Power Sensor	Agilent Technologies	8482A	3290	12	16-Jan-2016
ESA-E Series Spectrum Analyser	Agilent Technologies	E4402B	3348	12	5-Sep-2015
Cable (1m, N Type)	Rhophase	NPS-1601-1000-NPS	3351	12	29-Apr-2015
Cable (1m, N Type)	Rhophase	NPS-1601-1000-NPS	3354	12	29-Apr-2015
Cable (2m, N Type)	Rhophase	NPS-1601-2000-NPS	3356	12	3-Dec-2015

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

SECTION 4

PHOTOGRAPHS

4.1 PHOTOGRAPHS OF EQUIPMENT UNDER TEST (EUT)

50 Ω Conducted Sample

EUT in Float Free Cradle

Water Ground Plane (Configurations 5)

Above Ground Plane (Configurations 8)

SECTION 5

ACCREDITATION, DISCLAIMERS AND COPYRIGHT

5.1 ACCREDITATION, DISCLAIMERS AND COPYRIGHT

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

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

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

ANNEX A

MANUFACTURER SUPPLIED INFORMATION

Tron 60GPS

Loss in antenna matching network

Background:

The adapter used to achieve 50 ohm's connectors for 406MHz and 121.5MHz measurements introduces signal loss.

Scope:

This applies to the 406MHz and 121.5MHz measurements on Tron 60GPS.

Method:

Two adapters is connected together and the total loss is measured using a network analyzer. The actual loss for one adapter is then found by divide the total loss by a two.

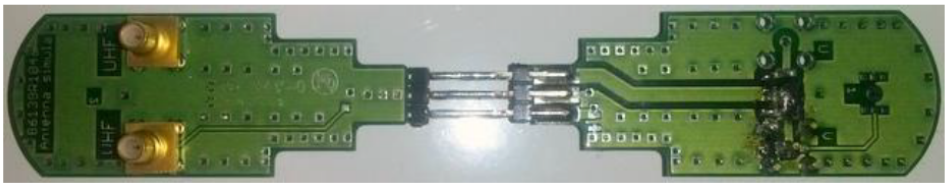
Measurements:

Total loss on 406MHz is 0.73dB
Total loss on 121.5MHz is 0.07dB

Conclusion:

0.36dB has to be added to the measurements done in the 50 ohm connector for 406MHz.

121.6MHz has no practical loss and shall therefore be used as is.



Figur 1: Picture showing two adapters together for loss measurements

Position data encoding (A.3.8.7)

Model: Tron60GPS
Serial number: 00000
Beacon SW: rel1.0.11
Protocol: Standard Location Protocol
Test Date: 18.12.2014

Table F-C.2: Position Data Encoding Results Standard Location Protocol

Script Reference (See Table D.2)	Value of Encoded Location Bits Transmitted by Beacon	Confirmation that BCH Correct (√)
1	Bits 65-85=0FFBFF Bits 113-132=83E0F	√
2	Bits 65-85=100400 Bits 113-132= 8420E Number of seconds after providing navigation data that beacon transmitted the above encoded location information: 47s	√
3	Bits 65-85= 000000 Bits 113-132= 8360D	√
4	Bits 65-85= 000ACF Bits 113-132= 0F222	√
5	Bits 65-85= 0012CE Bits 113-132= 93A60	√
6	Bits 65-85= 100ECF Bits 113-132= 0FA10	√
7	Bits 65-85= 1B2964 Bits 113-132= 80A00	√
8	Bits 65-85= 1B2D64 Bits 113-132= 84E00	√
9	Bits 65-85= 0B46D0 Bits 113-132= 03801	√
10	Bits 65-85= 0B42D0 Bits 113-132= 08009	√
11	Bits 65-85= 14962A Bits 113-132= 80200	√
12	Bits 65-85= 0FFBFF Bits 113-132= 83E0F	√
13	Bits 65-85= 0FFBFF Bits 113-132= 83E0F	√

Position data encoding (A.3.8.7)

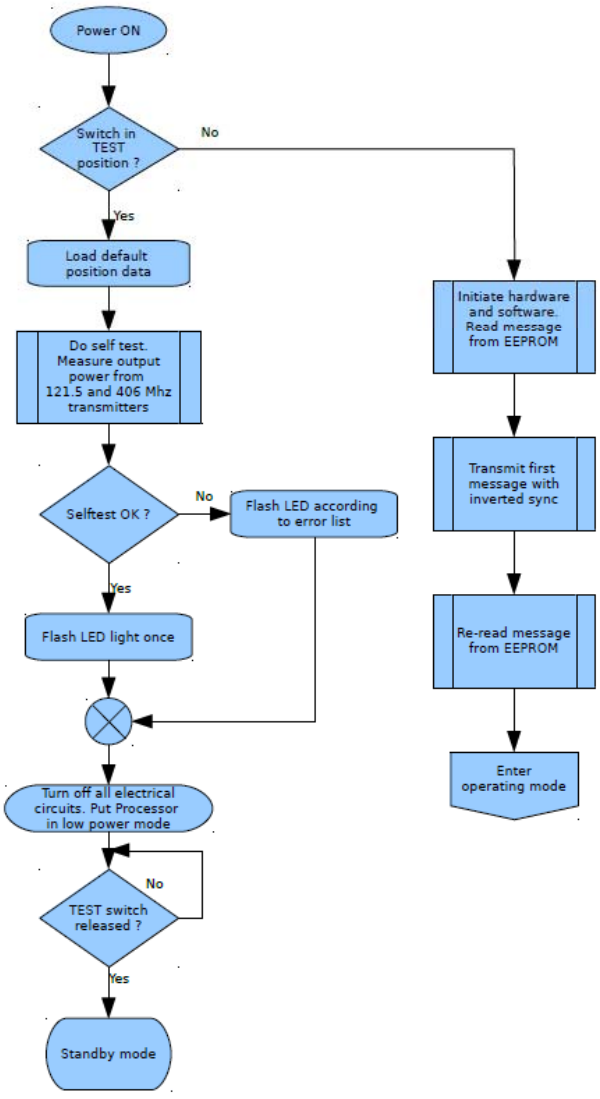
Model: Tron60GPS
Serial number: 00000
Beacon SW: rel1.0.11
Protocol: User Location Protocol
Test Date: 18.12.2014

Table F-C.1: Position Data Encoding Results User Location Protocol

Script Reference	Value of Encoded Location Bits Transmitted by Beacon 108-132	Confirmation that BCH Correct (√)
1	Bits 108-132=0FE0FF0	√
2	Bits 108-132=1001000 Number of seconds after providing navigation data that beacon transmitted the above encoded location information: 17s	√
3	Bits 108-132=0000000	√
4	Bits 108-132=0006B3C	√
5	Bits 108-132=1007B3C	√
6	Bits 108-132=1B28590	√
7	Bits 108-132=1B29590	√
8	Bits 108-132=0B41B40	√
9	Bits 108-132=0B3CB40	√
10	Bits 108-132=14918A7	√
11	Bits 108-132=0FE0FF0	√
12	Bits 108-132=0FE0FF0	√

Protection From Repetitive Self-Test Mode Transmissions

In self-test, the beacon is powered by a separate test switch, and a TEST signal will activate the self-test routine. After the microcontroller has performed the self-test routine, the microcontroller turns off all electrical circuits. Then the program runs in a wait loop until the TEST switch is released. Please see figure below.



GNSS Self-Test limited in number

GNSS Self-Test is activated by moving the switch to TEST-position twice within 3 seconds and released back to READY position. If more than allowed GNSS Self-Test's is already executed, this will be announced by 10 beep's and the EPIRB will power off.
If more GNSS Self-Test's is allowed, the counter is increased, a 120 seconds timer is started and the GNSS is switched on. If position is received before the timer stops, then a normal Self-Test is executed and the position is transmitted in the 406 message. The EPIRB power's off. In case of no position within the time limit, this will be announced by 5 beep's and the EPIRB will power off.

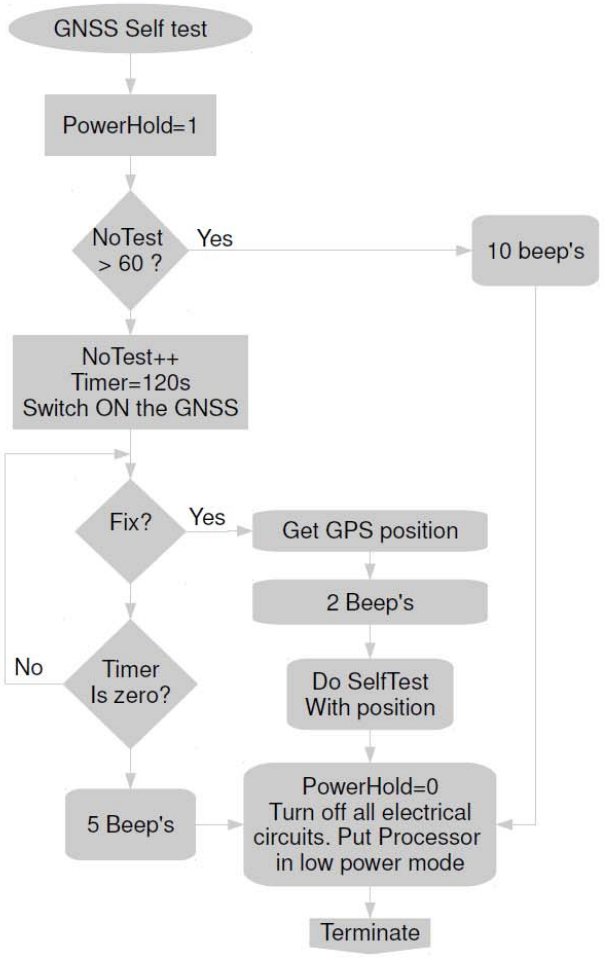


Figure 2: GNSS Self-Test flow chart

Protection Against Erroneous Position Encoding Into The Beacon Message

Tron 60GPS are using GPS module MAX-7 from uBlox.

The RMC messages are used for position update.

Only messages with status flag 'V' (Valid) and with the correct checksum are used.
Valid means 2D or 3D fix.

ANNEX B

EIRP RESULTS ADJUSTMENT

Recalculation of $EIRP_{min/max\ EOL}$

Recalculation of values of $EIRP_{min/max\ EOL}$ was required following the completion of the Operating Lifetime test.

Cospas Sarsat advised the following:

To recalculate the original EIRP test results:

i) Calculate the correction factor for the EIRP values as $EIRP_{CORR} = P_{t\text{-}CORR} - L_{ant\text{-}CORR}$

where:

$P_{t\text{-}CORR} = P_{t\text{-}CUR} - P_{t\text{-}ORG}$, *difference between current TA and original TA transmitter power levels* P_{tamb};

$L_{ant\text{-}CORR} = L_{ant\text{-}CUR} - L_{ant\text{-}ORG}$, *difference between current TA (e.g. min/max declared 406 MHz losses for external or remote antennas) and the original TA antenna cable loss, this could be not applicable for this case (i.e., Lant-CORR =0).*

Calculation of the Correction factors shall be included to the report.

ii) Adjust EIRP values adding correction factor ($EIRP_{CORR}$ *) to the EIRP values in the original TA tables F-B.1 and F-B.3*
The Tables with the adjusted EIRP values shall be included to the report.

iii) Annotate the EIRP Tables with adjusted EIRP values, as per sections B.10.2.

iv) Calculate $EIRP_{min/max\ EOL}$ *as per sections B.10.3 and B.10.4 and conclude about compliance with C/S requirements.*

v) If needed, measurement uncertainty (MU) allowance of 1 dB is applicable to a limited number of points as described in section A.1 of C/S T.007.

Below are the results obtained during the **original Type Approval carried out by Omega Test laboratory** as found in 'Test Report N.11/9 Issue 4', dated December 14 2011:

Table F-B.1: Effective isotropically radiated power (dBm) / antenna gain (dBi)

Azimuth Angle (degrees)	Elevation Angle (degrees)				
	10	20	30	40	50
0	38,24 / 1,77	37,23 / 0,77	37,66 / 1,20	36,46 / 0,00	35,71 / -0,76
30	38,91 / 2,44	37,33 / 0,87	37,33 / 0,86	36,34 / -0,12	36,13 / -0,34
60	38,01 / 1,55	37,95 / 1,48	38,02 / 1,56	36,23 / -0,23	35,62 / -0,85
90	38,40 / 1,93	38,33 / 1,86	38,44 / 1,97	36,02 / -0,45	35,01 / -1,45
120	37,79 / 1,33	37,76 / 1,29	38,17 / 1,71	36,03 / -0,43	35,46 / -1,01
150	38,31 / 1,84	37,33 / 0,87	37,37 / 0,91	36,61 / 0,15	35,94 / -0,52
180	38,60 / 2,14	37,06 / 0,59	37,65 / 1,18	36,75 / 0,28	36,22 / -0,24
210	37,90 / 1,43	37,74 / 1,27	38,02 / 1,55	36,42 / -0,05	35,45 / -1,01
240	37,60 / 1,13	38,12 / 1,66	38,53 / 2,06	36,22 / -0,24	35,72 / -0,75
270	38,71 / 2,24	38,03 / 1,57	37,66 / 1,19	36,12 / -0,35	36,32 / -0,14
300	38,10 / 1,64	38,15 / 1,68	38,22 / 1,75	36,43 / -0,04	36,03 / -0,43
330	37,60 / 1,13	38,02 / 1,56	38,13 / 1,67	36,37 / -0,10	35,48 / -0,98
Overall Gain Variation	1,31	1,27	1,20	0,73	1,31

$EIRP_{LOSS} = Pt_{ambient} - Pt_{EOL} = 36.47 - 36.76 = -0.29$ dB

where $Pt_{ambient}$ is output power measured during A.2.1 test at +20 °C

Pt_{EOL} is minimum transmitter power measured during A.2.3 test

$EIRP_{max\,EOL} = MAX [EIRP_{max} , (EIRP_{max} - EIRP_{LOSS})] = MAX (38.91 , 39.20) = 39.20$ dBm ($\leq$ 43 dBm)

$EIRP_{min\,EOL} = MIN [EIRP_{min} , (EIRP_{min} - EIRP_{LOSS})] = MIN (35.01 , 35.30) = 35.01$ dBm ($\geq$ 32 dBm)

Table F-B.3: Equivalent Isotropically Radiated Power (dBm) / Antenna Gain (dBi)

Azimuth Angle (degrees)	Elevation Angle (degrees)				
	10	20	30	40	50
0	36,04 / -0,36	36,83 / 0,43	36,12 / -0,27	33,61 / -2,78	31,21 / -5,19
90	35,93 / -0,46	36,73 / 0,34	36,74 / 0,35	33,52 / -2,88	31,03 / -5,37
180	36,03 / -0,37	36,83 / 0,44	35,94 / -0,45	34,01 / -2,38	30,82 / -5,58
270	35,83 / -0,56	36,53 / 0,13	35,83 / -0,57	33,31 / -3,08	30,70 / -5,69
Overall Gain Variation	0,20	0,31	0,92	0,70	0,50

$EIRP_{LOSS} = Pt_{ambient} - Pt_{EOL} = 36.47 - 36.76 = -0.29$ dB

where $Pt_{ambient}$ is output power measured during A.2.1 test at +20 °C

Pt_{EOL} is minimum transmitter power measured during A.2.3 test

$EIRP_{max\,EOL} = MAX [EIRP_{max} , (EIRP_{max} - EIRP_{LOSS})] = MAX (36.83 , 37.13) = 37.13$ dBm ($\leq$ 43 dBm)

$EIRP_{min\,EOL} = MIN [EIRP_{min} , (EIRP_{min} - EIRP_{LOSS})] = MIN (30.70 , 31.00) = 30.70$ dBm ($\geq$ 30 dBm)

Accordingly, The values will be adjusted as follows;

$P_{t\text{-}CORR}$ = 37.23 ($P_{t\text{-}CUR}$) – 36.47 ($P_{t\text{-}ORG}$) = 0.76dB

$L_{ant\text{-}CORR}$ = 0.36 ($L_{ant\text{-}CUR}$) – 0.6 ($L_{ant\text{-}ORG}$) = -0.24dB

$EIRP_{CORR}$ = 0.76 – (-0.24) = 1.00dB

Therefore:

Table F-B.1 (Omega Test Lab Results + $EIRP_{CORR}$)

	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	39.24	2.77	38.23	1.77	38.66	2.2	37.46	1	36.71	0.24
30	39.91	3.44	38.33	1.87	38.33	1.86	37.34	0.88	37.13	0.66
60	39.01	2.55	38.95	2.48	39.02	2.56	37.23	0.77	36.62	0.15
90	39.4	2.93	39.33	2.86	39.44	2.97	37.02	0.55	36.01	-0.45
120	38.79	2.33	38.76	2.29	39.17	2.71	37.03	0.57	36.46	-0.01
150	39.31	2.84	38.33	1.87	38.37	1.91	37.61	1.15	36.94	0.48
180	39.6	3.14	38.06	1.59	38.65	2.18	37.75	1.28	37.22	0.76
210	38.9	2.43	38.74	2.27	39.02	2.55	37.42	0.95	6.45	-0.01
240	38.6	2.13	39.12	2.66	39.53	3.06	37.22	0.76	36.72	0.25
270	39.71	3.24	39.03	2.57	38.66	2.19	37.12	0.65	37.32	0.86
300	39.1	2.64	39.15	2.68	39.22	2.75	37.43	0.96	37.03	0.57
330	38.6	2.13	39.02	2.56	39.13	2.67	37.37	0.9	36.48	0.02

$EIRP_{LOSS}$ = $P_{t\ ambient}$ (37.23) – $P_{t\ EOL}$ (37.19) = 0.04dB (Note: these values are taken from the summary table of this report)

$EIRP_{max\ EOL}$ = MAX [$EIRP_{max,}$ ($EIRP_{max}$ - $EIRP_{LOSS}$)] = MAX (39.91*, 39.87) = 39.87dBm (<43dBm)
$EIRP_{min\ EOL}$ = MIN [$EIRP_{min,}$ ($EIRP_{min}$ - $EIRP_{LOSS}$)] = MIN (36.01*, 35.97) = 35.97dBm (>32dBm)

* Values from Table F-B.1 of original Type Approval + $EIRP_{CORR}$

Table F-B.3

	Elevation Angle (degrees)									
	10		20		30		40		50	
Azimuth Angle (Degrees)	EIRP dBm	Ant dBi	EIRP dBm	Ant dBi	EIRP dBm	Ant dBi	EIRP dBm	Ant dBi	EIRP dBm	Ant dBi
0	37.04	0.64	37.12	1.43	37.12	0.73	34.61	-1.78	32.21	-4.19
90	36.93	0.54	37.73	1.34	37.74	1.35	34.52	-1.88	32.03	-4.37
180	37.03	0.63	37.83	1.44	36.94	0.55	35.01	-1.38	31.82	-4.58
270	36.83	0.44	37.53	1.13	36.83	0.43	34.31	-2.08	31.7	-4.69

$EIRP_{LOSS}$ = $P_{t\ ambient}$ (37.23) – $P_{t\ EOL}$ (37.19) = 0.04dB (Note: these values are taken from the summary table of this report)

$EIRP_{max\ EOL}$ = MAX [$EIRP_{max,}$ ($EIRP_{max}$ - $EIRP_{LOSS}$)] = MAX (37.83*, 37.79) = 37.83dBm (<43dBm)
$EIRP_{min\ EOL}$ = MIN [$EIRP_{min,}$ ($EIRP_{min}$ - $EIRP_{LOSS}$)] = MIN (31.70*, 31.66) = 31.66dBm (>30dBm)

* Values from Table F-B.3 of original Type Approval + $EIRP_{CORR}$

Summary

The adjusted results for $EIRP_{min/max\ EOL}$ are within the limits stated in C/S T.007.