



**Add value.
Inspire trust.**

Report On

Emergency Beacons Testing of the
Ocean Signal Limited
PLB3
In accordance with Cospas-Sarsat T.007

Document 75950037 Report 01 Issue 5

August 2022



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

REPORT ON

Emergency Beacons Testing of the
Ocean Signal Limited
PLB3

Document 75950037 Report 01 Issue 5

August 2022

PREPARED FOR

Ocean Signal Limited
Unit 4
Ocivan Way
Margate
CT9 4NN

PREPARED BY

A handwritten signature in black ink that reads 'C. Bland'.

Chris Bland
Technician (Marine RF)

APPROVED BY

A handwritten signature in black ink that reads 'M. Hardy'.

Martin Hardy
Authorised Signatory

DATED

02 August 2022





CONTENTS

Section	Page No
1	REPORT SUMMARY 3
1.1	Introduction 4
1.2	Application Form..... 5
1.3	Product Information 16
1.4	Test Locations 21
1.5	Modifications..... 21
1.6	Report Modification Record 22
2	TEST DETAILS 23
2.1	Test Results Summary Table 24
2.2	Power Output (Electrical and Functional Tests at Constant Temperature)..... 43
2.3	Digital Message (Electrical and Functional Tests at Constant Temperature) 45
2.4	Modulation (Electrical and Functional Tests at Constant Temperature) 49
2.5	406 MHz Transmitted Frequency (Electrical and Functional Tests at Constant Temperature) 52
2.6	Spurious Emissions into 50 Ohms (Electrical & Functional Tests at Constant Temperature) .. 59
2.7	406 MHz VSWR Check (Electrical and Functional Tests at Constant Temperature) 62
2.8	Self-test Modes (Electrical and Functional Tests at Constant Temperature)..... 70
2.9	Thermal Shock..... 90
2.10	Operating Lifetime at Minimum Temperature 94
2.11	Frequency Stability Test with Temperature Gradient 114
2.12	Satellite Qualitative Tests 124
2.13	Beacon Antenna Test 134
2.14	Navigation System Test..... 138
2.15	Beacon Coding Software 145
2.16	RLM reception Verification 146
2.17	Testing Operator Controls 160
3	TEST EQUIPMENT USED 164
3.1	Test Equipment..... 165
3.2	Measurement Uncertainty 170
4	PHOTOGRAPHS..... 171
4.1	Photographs of Equipment Under Test (EUT) 172
5	ACCREDITATION, DISCLAIMERS AND COPYRIGHT..... 177
5.1	Accreditation, Disclaimers and Copyright..... 178
ANNEX A	Manufacturer Supplied Information A.2
ANNEX B	Modification State Comparison Data B.2



SECTION 1

REPORT SUMMARY

Emergency Beacons Testing of the
Ocean Signal Limited
PLB3



1.1 INTRODUCTION

The information contained in this report is intended to show verification of the Ocean Signal Limited PLB3 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	Ocean Signal Limited
Model Number(s)	PLB3
Manufacturer Declared Variant	PLB-450*1
Serial Number(s)	TA000005 (conducted PLB3) TA000012 (radiated PLB3) TA000011 (radiated PLB-450) TA000003 (RLS PLB3)
Number of Samples Tested	4
Test Specification/Issue/Date	Cospas-Sarsat T.007 Issue 5 Rev 5 May 2020 Cospas-Sarsat T.007 Issue 5 Rev 7 June 2021*2
Date of Receipt of Test Samples	21 December 2020
Order Number	10113
Date	03 September 2020
Start of Test	21 December 2020*3
Finish of Test	22 April 2022
Name of Engineer(s)	M Sellers C Bland
Related Documents	Cospas-Sarsat T.001 Issue 4 Rev 6 May 2020 Cospas-Sarsat T.IP (TCXO) Issue 1 Rev 5 Oct 2013

*1Refer to Annex A for Manufacturer variant information. Additionally, it was agreed with Cospas-Sarsat that additional testing of Satellite Qualitative would be carried out on the alternate branded PLB (ref email dated: 13 Sept 2021 16:19. RE: Pre-applications: PA20-09: PLB3/PLB-450 - TUV Type Approval Test Status and Proposed Firmware Update).

*2The RLS tests (A.3.8.8) were carried out in accordance with Cospas-Sarsat T.007 Issue 5 Rev 6 October 2021. All other testing was carried out in accordance with Cospas-Sarsat T.007 Issue 5 Rev 5 May 2020 (ref email dated: 20 Oct 2021 20:04. RE: T.007 questions).

*3Testing originally started in December 2020, however failures were identified. The Manufacturer updated the EUT, and testing restarted with Modification State 0 test data as presented in this report from July 2021.



1.2 APPLICATION FORM

G.1 - Beacon Manufacturer and Beacon Model	
Beacon Manufacturer	Ocean Signal Ltd
Beacon Manufacturer's Address	Unit 4 Ocivan Way, Margate, Kent, CT9 4NN
Beacon Model Name	PLB3
Additional Beacon Model Names	rescueME PLB3, PLB-450, ResQLink AIS

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

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



G.1 - Beacon Characteristics	
Characteristic	Declared Value
Operating frequency (406 MHz operating channel = 406.nnn)	406.031 MHz
Operating temperature range	Tmax= 55 °C
Temperature, at which minimum duration of continuous operation is expected (Submit C/S T.007 Section 5, part s, if applicable)	OR Other (nm °C) N/A
Manufacturer-declared Minimum Operating Lifetime* * this value is specified by National Administrations or International Organisations	Yes
	No
	No
	No
	N/A
Beacon power supply type (internal non-rechargeable, internal re-chargeable, external, combined, other)	Internal non-rechargeable
External power supply parameters (AC/DC, nominal voltage, nominal minimum and nominal maximum voltage)	Current (AC / DC):
	Nominal Voltage (V):
	Nominal Minimum Voltage (V):
	Nominal Maximum Voltage (V):
Is external power supply needed to energise the beacon or its ancillary devices in any of operational modes (N/A or Yes or No)	No
Battery cell chemistry	Li/FeS ₂
Battery cell model name, cell size, number of cells in a battery pack, and details of the battery pack electrical configuration	Cell Model Name:
	Cell Size:
	Number of Cells in Battery Pack:
	Details of the battery pack electrical configuration:
Battery cell manufacturer	Energizer
Battery pack manufacturer and part number	Battery Pack Manufacturer Name: Battery Pack Part Number:
Beacon manufacturers declared maximum allowed cell shelf-life (from date of cell manufacture to date of battery pack installation in the beacon)	2
Declared beacon battery replacement period (from date of installation in the beacon to expiry date marked on the beacon)	10



Oscillator type (e.g. OCXO, MCXO, TCXO)	TCXO
Oscillator manufacturer	Rakon
Oscillator model name/ part number	Model Name: E6907LF Part Number: E6907LF
Oscillator satisfies long-term frequency stability requirements (Yes or No)	Yes
Antenna type: Integral or Other (e.g. External, Detachable – specify type)	Integral
Antenna manufacturer	Ocean Signal Ltd
Antenna part name and part number (OEM, if applicable, and beacon manufacturer's)	OEM Model Name: N/A OEM Part Number: N/A Beacon Manufacturer's Model Name: 1305-03337 Beacon Manufacturer's Part Number: 1305-03337
Antenna cable assembly min/max RF- losses at 406 MHz, if applicable	Minimum loss (dB): N/A Maximum loss (dB): N/A
Navigation device type (Internal, External or None)	Internal
Features in beacon that prevent degradation to 406 MHz signal or other beacon performances resulting from a failure of navigation device or failure to acquire position data (Yes, No, or N/A)	Yes
Features in beacon that ensure erroneous position data is not encoded into the beacon message (Yes, No or N/A)	Yes
Navigation device capable of supporting global coverage (Yes, No or N/A)	Yes
Encoded position update capability (Yes, No, N/A) and	Yes
Encoded position update interval value (range)	3.96 to <15.00 minutes
For Internal Navigation Devices	
Geodetic reference system (WGS 84 or GTRF)	WGS 84
GNSS receiver cold start forced at every beacon activation (Yes or No)	Yes
Navigation device manufacturer	Ublox
Navigation device model name and part Number	Model Name: MAX-M8Q Part Number: MAX-M8Q
Internal navigation device antenna type(integrated, internal, external, passive/active) , manufacturer and model	Internal, AEL Crystals Ltd, DAE1575R1820A
GNSS system supported (e.g. GPS, GLONASS, Galileo)	GPS, Galileo



For External Navigation Devices	
Data protocol for GNSS receiver to beacon interface	N/A
Physical interface for beacon to navigation device	N/A
Electrical interface for beacon to navigation device	N/A
Part number of the external navigation interface device (if applicable)	N/A
Navigation device model and manufacturer (if beacon designed to use specific devices)	N/A
Self-Test Mode Characteristics:	Self-Test Mode
Activated by a separate switch/ separate switch position (Yes or No)	Yes
Self-test/GNSS self-test mode switch automatically returns to normal position when released (Yes or No)	Yes
Self-test/ GNSS self-test activation can cause an operational mode transmission (Yes or 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
Results of self-test / GNSS self-test are indicated by (provide details, e.g. Pass / Fail indicator light, strobe light, etc.)	Indicator LED / Strobe
The content of the encoded position data fields of the self-test message has default values	N/A
Performs an internal check and indicates that RF-power is being emitted at 406 MHz and 121.5 MHz, if beacon includes a 121.5 Hz homer (Yes or No)	No
Self-test results in transmission of a signal other than at 406 MHz (Yes & details or No)	Yes, 121.5MHz for 1sec, AIS
Self-test can be activated directly at beacon (Yes or No)	Yes
List of Items checked by self-test	<p>406 Power and frequency lock, AIS Synth, AIS Power and frequency lock, 121.5 Power, Battery Status</p> <p>GNSS *</p> <p>*(N.B. The GNSS self-test is limited to checking operation of the internal GNSS receiver only; if a fix is acquired during the test the beacon shall encode the position and perform a burst of 8 AIS transmissions followed by a 406MHz transmission. If a fix is not obtained the beacon shall not perform any transmission).</p>
Self-test/ GNSS self-test 406 MHz burst duration (440 or 520 ms)	520ms



Self-test message length format flag in bit 25, ("0" or "1")	1	1
Maximum duration of a self-test mode, sec	15.6	115.62
Maximum recommended number of self-tests / GNSS self-tests during battery pack replacement period (as applicable)	120	60
Distinct indication of self-test start (Yes or No)	Yes	Yes
Indication of self-test results (Yes or No)	Yes	Yes
Distinct indication of insufficient battery capacity (Yes or No)	Yes	N/A
Automatic termination of self-test mode immediately after completion of the self-test cycle (Yes or No)	Yes	Yes
GNSS Self-test results in transmission of a single burst, irrespectively of the test result (Yes or No)	N/A	No
Self-test / GNSS self-test can be activated from beacon remote activation points (Yes & details or No)	No	No
List all methods of Self-test mode and GNSS Self-test modes activation. Provide details on a separate sheet to describe	Test key only	Test key only
Repetitive Automated Interrogation of a Beacons Status (Yes & details per section 5.1, item (y), or No)	No	No



Message Coding Protocols	Protocol Option	Tick Where Appropriate (X)
User Protocol	Maritime with MMSI	
	Maritime with Radio Call Sign	
	EPIRB Float Free with Serial Number	
	EPIRB Non Float Free with Serial Number	
	Radio Call Sign	
	Aviation	
	ELT with Serial Number	
	ELT with Aircraft Operator and Serial Number	
	ELT with Aircraft 24-bit Address	
	PLB with Serial Number	
	National (Short Message Format)	
	National (Long Message Format)	
	EPIRB with MMSI	X
	EPIRB with Serial Number	
Standard Location Protocol	ELT with 24-bit Address	X
	ELT with Aircraft Operator Designator	X
	ELT with Serial Number	X
	PLB with Serial Number	X
	National Location: EPIRB	
	National Location: ELT	
National Location Protocol	National Location: PLB	X
	ELT with Serial Number	
	ELT with Aircraft Operator and Serial Number	
ELT(DT) Location Protocol	ELT with Aircraft 24-bit Address	
	ELT with Serial Number and 3LD in PDF-2	
	ELT with Aircraft 24-bit Address and 3LD in PDF-2	
	EPIRB	
RLS Location Protocol (TAC or NRN and Serial Number)	ELT	
	PLB	X
	EPIRB	
RLS Location Protocol (MMSI)	PLB	X




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			
Declared Value			
Other Declarations			
Beacon includes a homer transmitter(s) (Yes or No)	Yes		
- homer transmitter(s) frequency and power	Frequency	Power (dBm)	Yes / No
	121.5 MHz	16dBm ±2dBm	Yes
	243.0 MHz	N/A	No
	AIS	31.5 ±0.5dBm	Yes
	Other (MHz)		
	N/A	N/A	No
	Description:	<< Description >>	
homer transmitter(s) duty cycle	97 (121.5MHz)	%	
duty cycle of homer swept tone	37 (121.5MHz)	%	
Beacon includes a high intensity flashing light (e.g. Strobe)	Yes		
- light intensity	>1	cd	
- flash rate	24	flashes per minute	
Beacon transmission repetition period satisfies C/S T.001 requirement that two beacon's repetition periods are not synchronised closer than a few seconds over 5 minute period, and the time intervals between transmissions are randomly distributed on the interval 47.5 to 52.5 seconds (Yes or No)	Yes		



<p>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.</p>	<p>When correctly packed in a life jacket the PLB3/PLB-450 will activate when the life jacket inflates (reference beacon user manual section 2.1). This is a "semi-autonomous" means of activating the "manual" mechanism when installed in an inflatable PFD. This, therefore, does not constitute a truly "automatic" means of activation, and hence does not require a separate coding indication in the beacon message. i.e., the manual means of beacon activation is transferred to the activation of the PFD inflation mechanism.</p>
<p>Beacon includes automatic activation mechanism (Yes or No). Specify type of automatic beacon activation mechanism</p> <p>Beacon includes a voice-transceiver (Yes or No), and if Yes specify:</p> <p>Voice transmitter nominal output power</p> <p>Voice transmitter operating frequencies</p> <p>- provides prevention against continuous operation of voice transmitter (Yes or No), and if Yes specify:</p> <p>- maximum continuous voice-transmission operation ("time-out timer")</p> <p>- maximum cumulative transmit-mode on-time ("On time")</p>	<p>Yes / No : No</p> <p>Description: N/A</p> <p>Yes / No : No</p> <p>If Yes, specify: (dBm) N/A</p> <p>If Yes, specify: (MHz) N/A</p> <p>Yes / No : N/A</p> <p>"Time-out timer" (minutes): N/A</p> <p>On time (hours : minutes): N/A</p>
<p>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</p>	<p>Yes</p> <p>Description: Near-Field Communication (NFC)</p>
<p>Beacon model hardware part number (P/N) and version</p>	<p>9005-03356 Issue 01.00 (PLB3, rescueME PLB3) , 9005-03767 Issue 01.00 (PLB-450, ResQLink AIS)</p>
<p>Beacon model firmware P/N, version, date of issue/releases</p>	<p>5005-03492 Issue 01.00</p>
<p>Beacon model software P/N, version, date of issue/releases</p>	<p>N/A</p>
<p>Beacon model printed circuit board P/N and version</p>	<p>1015-02834 Issue 01.00</p>
<p>Beacon model multiple programmable options, except message coding protocols (Yes/No)</p>	<p>No</p> <p>If Yes, List all programmable options associated with this type-approval application: N/A</p>
<p>Known non-compliances with C/S T.001 requirements (Yes or No). If Yes, provide details (Submit C/S T.007 Section 5, part t, if applicable)</p>	<p>Yes</p>



Beacon Manufacturer Point of Contact (POC) for this Type Approval application:	
Name and Job Title:	Mark Newton / Approvals Manager
Phone:	+44 1843 808028
E-mail:	mark.newton@oceansignal.com
Dated(*)	21-06-2022
Signed(*) (Name, Position and Signature of Beacon Manufacturer Representative)	 Mark Newton / Approvals Manager



Information Provided by the Cospas-Sarsat Accepted Test Facility

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

Date of Submission for Testing: 21 December 2020

Applicable C/S Standards:

Document	Issue	Revision	Date
C/S T.001	4	6	May 2020
C/S T.007	5	5	May 2020
IP (TCXO)	-	5	October 2013

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

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

Non-compliances:

For T.007 A.3.2.4 the Modulation phase deviation (negative) measurement is outside the limits stated in C/S T.007. However, the result is within the Test Facility Accuracy stated in C/S T.008.

For T.007 A.2.6 the Beacon Antenna Test results at 30, 150 and 210 degrees exceeds the limits stated in C/S T.007. However, the results are within the Test Facility Accuracy stated in C/S T.007, clause A.1.

For T.007 A.3.1.1.1, the Repetition Rate at maximum and minimum temperatures exceeds the limits stated in C/S T.007. However, the result is within the Test Facility Accuracy stated in C/S T.008.



Deviations:

The UTC Test, clause A.3.8.8.2 was carried out with the Hex ID identified in T.007 Issue 5 – Revision 7 June 2021 as the EUT RLS sample had been programmed with the Hex ID specified in this version of the standard. The test was performed in all applicable configurations as per T.007 Issue 5 revision 5 May 2020.

Operating Lifetime at Minimum Temperature test, clause A.2.3 was carried out with a battery discharged more than required for T.007. This was to comply with RTCM Standard 11010.3.

As a result of discrepancies observed during testing (refer to section 1.5 for details), the beacon firmware was modified and limited regression testing of the modified beacon was carried out (as per C/S T.007, section 4.9). Other tests not required for regression testing were included based on the previous modification states as indicated for each test in the summary table and relevant test sections within this report.

The EUT complies with T.001 clause 4.5.5.4 and is compliant with T.007 clause A.3.8.3 but deviates from the requirements of Annex B Table F.1 element 17.

Notes: None.

Signed:	
Name:	Martin Hardy
Position Held:	Authorised Signatory
Date:	02 August 2022

1.3 PRODUCT INFORMATION

1.3.1 Technical Description

The Equipment Under Test (EUT) was an Ocean Signal Limited a PLB3 as shown in the photograph below. A full technical description can be found in the manufacturer's documentation.



Equipment Under Test (Showing modified 50Ω conducted outputs)



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 (TA000005 / TSR005). The test configuration for all tests is identical with the exception of Antenna Characteristics, Satellite Qualitative, Position Acquisition Time and Position Accuracy and the RLM Reception Verification tests.

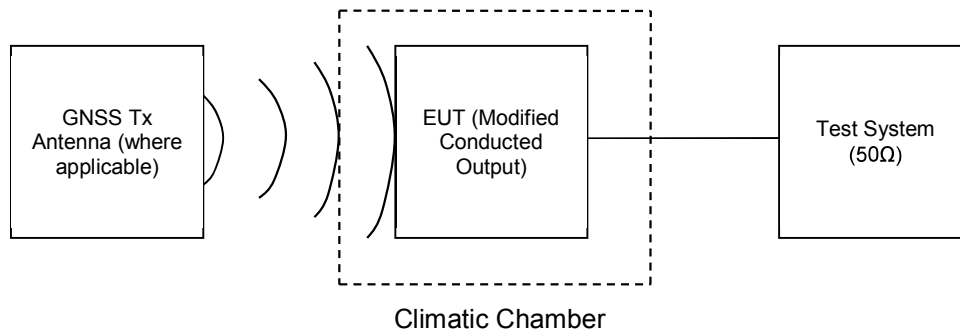
The second and third EUTs were fully packaged beacons, similar to the proposed production beacons equipped with their proper antenna. The first of these EUTs (TA000011 / TSR014) was the PLB-450 variant and was used to perform Antenna Characteristics, Satellite Qualitative and Position Acquisition Time and Position Accuracy. The test configuration for these tests is a function of the beacon type and the operational environments supported by the beacon, as declared by the manufacturer. The second of these EUTs was an Ocean Signal PLB3 model which was used to perform Satellite Qualitative test in the alternate colour (and branding) (TA000012 / TSR013).

The fourth EUT was a fully packaged beacon with an additional NMEA data stream output which enabled monitoring of the GNSS Receiver for the RLM Reception Verification tests (TA000003 / TSR026).

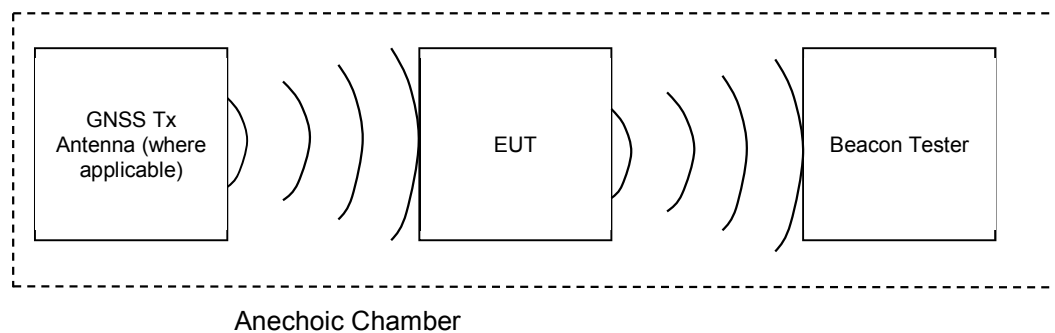
Manufacturer Reference	TUV SUD Reference	Configuration	Brand (colour)
TA000005	TSR005	Conducted	Ocean Signal PLB3 (yellow)
TA000011	TSR014	Radiated	ACR PLB-450 (chartreuse)
TA000012	TSR013	Radiated	Ocean Signal PLB3 (yellow)
TA000003	TSR026	Radiated with NMEA data output	Ocean Signal PLB3 (yellow)

System Configurations

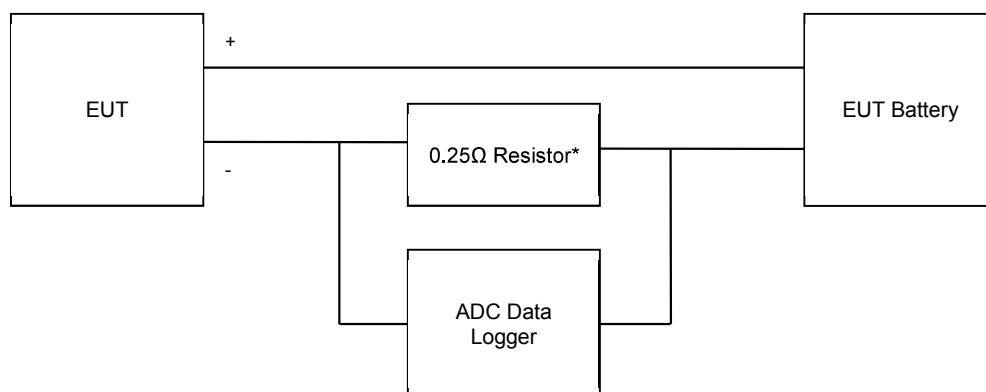
Conducted Laboratory Tests



A.3.8.3 Navigation Test



Battery Current Measurements



Note: The resistor in series with negative line of battery.

* Removed for Standby mode measurements. Leakage current measured through Data Logger (Nominal resistance 1MΩ).

For other Navigation, Satellite and Antenna test configurations, see photographs in section 4 of this report.



Further Information

Battery current measurements (see 'Operating lifetime', section 2.7) concluded that the 'worst case' (highest current) operating mode of the EUT was TUV Ref: A4 – No Ancillaries, ON at EUT (GNSS Search)*

* Subject to GNSS Receiver Duty Cycle.

All tests were carried out in this mode.

The EUT is fitted with a Rakon TCXO. The model and serial number of this oscillator used for this Type Approval is: Model: E6907LF, S/No: PC0371. Test sample TA000005 / TSR005.

The EUT is fitted with an internal GNSS receiver (uBlox Max-M8Q). From cold start, without GNSS signal data present, the duty cycle of the receiver is as described in the manufacturer information (see Annex A). After a 15 minute warm up, electrical and functional tests were carried out for 30 minutes to ensure that measurements were made during periods when the GNSS receiver was active and inactive.

Power Alignment

The manufacturer has provided evidence of output power alignment (see manufacturer document 921S-03997 Iss 01.00 PLB3 & PLB450 Test Samples - Conducted PWR Alignment.pdf).



1.3.3 Modes of Operation

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

Off/Standby Mode

- No apparent activity

Self-test

- Test button held and released between 1 and 5 seconds
- List of items checked as per Customer Supplied Information (Application Form)
- Navigation data applied at ambient temperature

GNSS Self-test

- Test button held and released between >5 and 10 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

- On button press
- 121.5 Homer active and offset
- AIS active
- GNSS operating in normal duty cycle for the following navigation input conditions
- No navigation data applied (unless otherwise stated)

All Navigation input descriptions are applicable to all tests unless otherwise stated.



1.4 TEST LOCATIONS

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

1.5 MODIFICATIONS

Modification State (Mod State)	Date of Implementation	Reasons for modification	Description of modification, HW/FW P/Ns, SW version/release after modification
0	22/06/2021	to fix an issue with GNSS ST, the method used to get a UTC time has been changed so a full almanac is not needed	Firmware version: 0.1.24 Hardware version: 900S-03356 Issue 01.00(PLB3), 900S-03767 Issue 01.00 (PLB-450) Software version: N/A
1	06/09/2021	To enable decoding of the RLM message when in test mode	Firmware version 00.02.00 Hardware version: 900S-03356 Issue 01.00(PLB3), 900S-03767 Issue 01.00 (PLB-450) Software version: N/A
2	25/10/2021	To fix issue with TOOC	Firmware version 00.03.00 Hardware version: 900S-03356 Issue 01.00(PLB3), 900S-03767 Issue 01.00 (PLB-450) Software version: N/A
3	07/04/2022	Update for the AIS true heading parameter	Firmware version 00.04.00 Hardware version: 900S-03356 Issue 01.00(PLB3), 900S-03767 Issue 01.00 (PLB-450) Software version: N/A

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.



Following the modification of the original EUT design an additional scope of testing was agreed between the Cospas-Sarsat Secretariat and the device manufacturer:

Additional Testing Requirement	Reference(s)	Details
<ul style="list-style-type: none"> • Beacon coding software (A.2.8): Ocean Signal to provide • Satellite Qualitative Tests (A.2.5) • Functional tests at ambient (A.2.1) and comparison with previous modification state • Current measurements (A.2.3) and comparison with previous mod state in RLS condition 	<p>Ref email dated: 13 Sept 2021 15:14 but as modified 13 Sept 2021 16:19</p> <p>Subject: RE: Pre-applications: PA20-09: PLB3/PLB-450 - TUV Type Approval Test Status and Proposed Firmware Update</p>	<p>A change from MS0 to MS1 was made following identification of an error with the decoding of the RLM message in test mode.</p> <p>Discussions with the C/S Secretariat indicated the scope of testing as per the Additional Testing Requirement column.</p> <p>In addition, the two EUTs models were discussed, and it was agreed to complete the following additional tests on the alternate model:</p> <ul style="list-style-type: none"> • Satellite Qualitative Tests in all applicable configurations.
<ul style="list-style-type: none"> • Functional tests at ambient temperature (A.2.1) including comparison to previous modification state. • Satellite Qualification in one configuration (A.2.5) • Testing of operator controls (A.3.10) 	<p>Ref email dated: 07 Oct 2021 21:46</p> <p>RE: Pre-applications: PA20-09: PLB3/PLB-450 - Type Approval Testing - Firmware Change Required</p>	<p>A change from MS1 to MS2 was made following identification of errors with the Testing of Operator Controls feature.</p> <p>Discussions with the C/S Secretariat indicated the scope of testing as per the Additional Testing Requirement column.</p> <p>Refer to Annex B for Modification State Comparison data.</p>
<ul style="list-style-type: none"> • Functional tests at ambient temperature (A.2.1). • Satellite Qualification in one configuration (A.2.5) • Worst case current measurements comparisons 	<p>Ref email dated: 12 April 2022 14:29</p> <p>RE: Plb3 worksheet</p>	<p>A change from MS2 to MS3 was made following identification of errors in the AIS stack, which caused an incorrect True Heading reading.</p> <p>Discussion with the C/S Secretariate indicated the scope of testing as per the Additional Testing Requirement column.</p> <p>Refer to Annex B for Modification State Comparison data.</p>

1.6 REPORT MODIFICATION RECORD

Issue 1 – First Issue.

Issue 2 – Update to Annex A document as supplied by Manufacturer.

Issue 3 – Satellite Qualitative and Beacon Antenna Test – sample name and serial numbers updated to match in the main body and summary table. Cell chemistry updated in F-E.2. Note added indicating protocol for self-test results in summary table. F-E.3 Line 5 updated. Satellite Qualitative results updated in summary table. Finish test date updated. Correction to verdict in Summary Table regarding compliance to navigation device update procedure in accordance with C/S T.001. Repetition rate results corrected and noted as a non-compliance. MS3 modification record entry (section 1.5). MS3 ambient CTT test data added to main summary table and main body of the report (sections: 2.1, 2.2, 2.3, 2.4, 2.5, 2.6, 2.8 and 2.12). Operating Lifetime modification state corrected in summary table. Battery current comparison table for all modification states added to annex B. Antenna characteristics EIRP calculations amended to consider the Pt ambient of MS3. Note added to Section 2.13 detailing the similar measurements for battery current in MS0 and MS1. Self-Test summary table updated with RLS results.

Issue 4 – Correction of typographical error (section 2.14.6).

Issue 5 – Reference to Manufacturer report for RLS GNSS Satellite Tracking added (summary table section 18 and report section 2.16).



SECTION 2

TEST DETAILS

Emergency Beacons Testing of the
Ocean Signal Limited
PLB3



2.1 TEST RESULTS SUMMARY TABLE

Parameters to be Measured	Range of Specification	Units	Test Results			Comments
			Tmin	Tamb	Tmax	
			(-20°C)	(+21°C)	(+55°C)	
1. Power Output						
Model: PLB3, S/N: TA000005, TUV Ref: TSR005 and Modification State 3 (Ambient Only)						
Model: PLB3, S/N: TA000005, TUV Ref: TSR005 and Modification State 0 (-20°C and +55°C)						
Transmitter power output (maximum) (minimum)	35 – 39	dBm	36.93 36.69	36.57 36.44	35.98 35.92	
Power output rise time (maximum) (minimum)	< 5	ms	0.42 0.29	0.34 0.33	0.45 0.43	
Power output 1ms before burst (maximum) (minimum)	< -10	dBm	-31.74 -32.12	-26.85 -41.93	-32.89 -33.37	
2. Digital Message Coding						
Model: PLB3, S/N: TA000005, TUV Ref: TSR005 and Modification State 3 (Ambient Only)						
Model: PLB3, S/N: TA000005, TUV Ref: TSR005 and Modification State 0 (-20°C and +55°C)						
Bit Sync	1 – 15	P / F	P	P	P	
Frame sync	16 - 24	P / F	P	P	P	
Format flag	25	bit value	1	1	1	
Protocol flag	26	bit value	0	0	0	
Identification / position data	27 - 85	P / F	P	P	P	RLS Protocol
BCH code	86 - 106	P / F	P	P	P	
Emerg. Code/nat. use/supplem. Data	107 - 112	bit value	111000	111000	111000	
Additional data / BCH (if applicable)	112 - 144	P / F	P	P	P	
Position Error (if applicable)	< 5	km	N/A	N/A	N/A	
Result: Pass						



Parameters to be Measured	Range of Specification	Units	Test Results			Comments
			Tmin	Tamb	Tmax	
			(-20°C)	(+21°C)	(+55°C)	
3. Digital Message Generator						
Model: PLB3, S/N: TA000005, TUV Ref: TSR005 and Modification State 3 (Ambient Only)						
Model: PLB3, S/N: TA000005, TUV Ref: TSR005 and Modification State 0 (-20°C and +55°C)						
Repetition rate, T_R :						
Average T_R	$48.5 \leq T_{Ravg} \leq 51.5$	seconds	50.49	50.48	50.40	* Results exceed the limits stated in C/S T.007. However, the measurements are within the Test Facility Accuracy stated in C/s T.008.
Minimum T_R	$47.5 \leq T_{Rmin} \leq 48.0$	seconds	48.001*	47.990	48.001*	
Maximum T_R	$52.0 \leq T_{Rmax} \leq 52.5$	seconds	52.10	52.11	52.29	
Standard deviation	0.5 - 2.0	seconds	1.41	1.40	1.46	
Bit rate		bits/sec	399.98	399.91	399.97	
Minimum fb	≥ 396	bits/sec	399.96	400.00	399.98	
Maximum fb	≤ 404					
Total transmission time		ms	N/A	N/A	N/A	
Short message	435.6 - 444.4	ms	N/A	N/A	N/A	
Long message	514.8 - 525.2	ms	520.30	519.63	520.16	
Unmodulated carrier			520.15	519.61	520.10	
Minimum T1	≥ 158.4	ms	160.88	160.41	160.72	
Maximum T1	≤ 161.6	ms	160.78	160.43	160.79	
First burst delay	≥ 47.5	seconds	56	56	56	

Result: Non-Compliance*



Parameters to be Measured	Range of Specification	Units	Test Results			Comments
			Tmin	Tamb	Tmax	
			(-20°C)	(+21°C)	(+55°C)	
4. Modulation						
Model: PLB3, S/N: TA000005, TUV Ref: TSR005 and Modification State 3 (Ambient Only)						
Model: PLB3, S/N: TA000005, TUV Ref: TSR005 and Modification State 0 (-20°C and +55°C)						
Biphase-L	P / F	P / F	P	P	P	
Rise time	(maximum) 50 - 250	µs	209.3	195.1	201.3	
	(minimum) 50 - 250	µs	186.3	162.3	177.3	
Fall time	(maximum) 50 - 250	µs	230.7	210.1	221.7	
	(minimum) 50 - 250	µs	203.7	183.4	196.6	
Phase deviation: positive	+(1.0 to 1.2)	radians	1.136	1.138	1.174	
	+(1.0 to 1.2)	radians	1.012	1.034	1.062	
Phase deviation: negative	-(1.0 to 1.2)	radians	-1.112	-1.161	-1.179	
	-(1.0 to 1.2)	radians	-0.994*	-1.048	-1.048	*Measurement outside the limits stated in C/S T.007. However, the result is within the Test Facility Accuracy stated in C/S T.008.
Symmetry measurement	≤ 0.05	radians	0.0269	0.0224	0.0274	
5. 406 MHz Transmitted Frequency						
Model: PLB3, S/N: TA000005, TUV Ref: TSR005 and Modification State 3 (Ambient Only)						
Model: PLB3, S/N: TA000005, TUV Ref: TSR005 and Modification State 0 (-20°C and +55°C)						
Nominal Value	C/S T.001	MHz	406.0311179	406.0310776	406.0310123	
	(maximum)		406.0311176	406.0310760	406.0310107	
	(minimum)		1.35E-9	5.83E-10	2.83E-10	
Short-term stability	≤ 2x10 ⁻⁹	/100ms	1.31E-9	5.49E-10	2.31E-10	
	(maximum)		1.38E-10	-1.66E-10	3.43E-10	
	(minimum)		-1.04E-10	-3.33E-10	1.48E-10	
Medium-term stability – Slope	(-1 to +1)x10 ⁻⁹	/minutes	1.13E-9	7.69E-10	1.27E-9	
	(maximum)		9.46E-10	3.62E-10	6.92E-10	
	(minimum)					
Medium-term stability – Residual frequency variation	≤ 3x10 ⁻⁹					
6. Spurious Emissions into 50ohms						
Model: PLB3, S/N: TA000005, TUV Ref: TSR005 and Modification State 3 (Ambient Only)						
Model: PLB3, S/N: TA000005, TUV Ref: TSR005 and Modification State 0 (-20°C and +55°C)						
In band (406.0 – 406.1 MHz)	C/S T.001 mask	P / F	P	P	P	
Result: Pass						



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						
Model: PLB3, S/N: TA000005, TUV Ref: TSR005 and Modification State 0						
Nominal Value	(maximum) (minimum)	MHz	406.0311097 406.0311085	406.0310508 406.0310499	406.0310330 406.0310317	
Modulation rise time	(maximum) (minimum)	µs	213.4 182.3	206.4 180.3	203.3 177.3	
Modulation fall time	(maximum) (minimum)	µs	229.7 203.6	222.7 198.7	220.6 196.6	
Modulation phase deviation: positive	(maximum) (minimum)	radians	1.1429 1.0064	1.1559 1.0354	1.1913 1.0414	
Modulation phase deviation: negative	(maximum) (minimum)	radians	-1.1160 -0.9829*	-1.1682 -1.0326	-1.1877 -1.0433	*Measurement outside the limits stated in C/S T.007. However, the result is within the Test Facility Accuracy stated in C/S T.008.
Modulation symmetry measurement	≤ 0.05	radians	0.0274	0.0270	0.0273	RLS Protocol
Digital Message	correct	P / F	P	P	P	



Parameters to be Measured	Range of Specification	Units	Test Results			Comments
			Tmin (-20°C)	Tamb (+21°C)	Tmax (+55°C)	
8(a). Self-test Mode						
Model: PLB3, SIN: TA000005, TUV Ref: TSR005 and Modification State 3 (Ambient Only) – RLS Protocol						
Model: PLB3, SIN: TA000005, TUV Ref: TSR005 and Modification State 1 (-20°C) – RLS Protocol						
Model: PLB3, SIN: TA000005, TUV Ref: TSR005 and Modification State 0 (+55°C) – RLS Protocol						
Frame sync	011010000	P / F	P	P	P	See Annex A
Format flag	1 / 0	bit value	1	1	1	
Single radiated burst	≤440 / 520 (±1%)	ms	519.672	519.531	520.116	
Default position data (if applicable)	correct	P / F	P	P	P	
Description	provided	Y / N	Y	Y	Y	
Design data on protection against repetitive self-test mode transmissions	provided	Y / N	Y	Y	Y	
Single burst verification	one burst	P / F	P	P	P	
Provides for 15 Hex ID	correct	P / F	P	P	P	
121.5 MHz RF power (if applicable)	verify that RF power emitted	P / F	P	P	P	
406 MHz power	verify that RF power emitted	P / F	P	P	P	
Distinct indication of Self-Test	provided	Y / N	Y	Y	Y	
Distinct indication of RF power being emitted	provided	Y / N	Y	Y	Y	
Indication of Self-Test result	provided	Y / N	Y	Y	Y	
Distinct indication of insufficient battery capacity	provided	Y / N	Y	Y	Y	
Maximum duration of Self-Test mode	≤ maximum duration of Self-Test	sec	15.6	15.6	15.6	Manufacturer specified value: 15.6 seconds
Automatic termination of Self-Test mode upon completion of Self-Test and indication of Self-Test results	verify automatic termination, irrespective of the switch position	Y / N	Y	Y	Y	

Result: Pass



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)						
Model: PLB3, SIN: TA000005, TUV Ref: TSR005 and Modification State 3 (Ambient Only)						
Model: PLB3, SIN: TA000005, TUV Ref: TSR005 and Modification State 1 (-20°C and +55°C)						
Frame sync	011010000	P / F	P	P	P	
Format flag	1 / 0	bit value	1	1	1	
Radiated burst duration	≤ 520 (+1%) must be within 500 m (or 5.25 km for User Location Protocol) of the actual position	ms	519.586	519.523	519.500	
Position data except for ELT (DT) (if applicable)		P / F	P	P	P	
Position data for ELT(DT)	must be within 200 m of the actual horizontal position and 700 m of the altitude	P / F	N/A	N/A	N/A	
Design data showing how GNSS Self-test is limited in number of transmissions and duration	provided	Y / N	Y	Y	Y	See Annex A
Single burst verification (if applicable)	one burst	P / F	P	P	P	
121.5 MHz RF power (if applicable)	verify that RF power is emitted	Y / N	Y	Y	Y	
406 MHz power (if applicable)	verify that RF power is emitted	Y / N	Y	Y	Y	
Maximum duration of GNSS Self-tests	Manufacturer to specify value	s	115	115	115	Manufacturer specified value: 115.62
Actual duration of Self-test with encoded location	Less than maximum duration	s	71	72	58	
Maximum number of GNSS Self-tests (only beacons with internal navigation devices)	Manufacturer to specify number	Number		60		Manufacturer specified number: 60
Distinct indication to register successful completion or failure of the GNSS self-test	must be provided	Y/N	Y	Y	Y	
Distinct indication that a maximum number of GNSS self-tests has been attained after GNSS self-test mode activation and without transmission of a test message or further GNSS receiver current drain	must be provided	Y/N	Y	Y	Y	
Automatic termination of the GNSS self-test mode upon completion of the GNSS self-test cycle and indication of the results	verify automatic termination of GNSS self-test mode, irrespective of the switch position	Y/N	Y	Y	Y	

Result: Pass



Parameters to be Measured	Range of Specification	Units	Test Results	Comments
9. Thermal Shock				
Model: PLB3, S/N: TA000005, TUV Ref: TSR005 and Modification State 1				
Soak Temperature	30°C difference	°C	20	Result: Pass
Measurement Temperature		°C	-10	
Transmitted Frequency			Min	
Nominal value	C/S T.001	MHz	406.0310727	
Short-term stability	$\leq 2 \times 10^{-9}$	/100ms	6.42E-10	
Medium-term stability – Slope	$(-2 \text{ to } +2) \times 10^{-9}$	/min	3.54E-11	
Medium-term stability – Residual frequency variation	$\leq 3 \times 10^{-9}$		5.86E-10	
Transmitter power output	35 - 39	dBm	36.69	
Digital message	correct	P/F	P	
			Max	
			406.0310844	
			7.72E-10	
			9.84E-10	
			1.48E-9	
			36.92	
			RLS Protocol	



Parameters to be Measured	Range of Specification	Units	Test Results	Comments
10. Operating Lifetime at Minimum Temperature				
Model: PLB3, S/N: TA000005, TUV Ref: TSR005 and Modification State 1 – battery current measurements (See section 2.10)				
Model: PLB3, S/N: TA000005, TUV Ref: TSR005 and Modification State 2				
Pre-test battery discharge duration (operating) required		AHours	0.3282	Result: Pass
Pre-test battery discharge duration (operating)		AHours	0.42827*	Battery discharged across a resistor at ambient temperature (constant current method). EUT self terminated.
Duration	>25 ^(see note)	Hours	46.59 Hours at T _{min} = -20°C	* The EUT battery was discharged more than required by the calculations required by Cospas Sarsat to meet the requirements of RTCM Standard 11010.3.
Effective Operating Lifetime duration	>25 ^(see note)	Hours	46.59 Hours at T _{min} = -20°C	Min/Max results are up to the manufacturer declared lifetime of 25hrs ^(see note) . MTS results exclude the first 30 mins of data (included in the test results section of this report).
Transmitted Frequency	C/S T.001	MHz	Min 406.0311104	RLS Protocol
Nominal value	≤ 2x10 ⁻⁹	/100ms	Max 406.0311243	
Short-term stability	(-1 to +1)x10 ⁻⁹	/min	1.10E-09	
Medium-term stability – Slope	≤ 3x10 ⁻⁹		-1.34E-10	
Medium-term stability – Residual frequency variation	35 - 39	dBm	5.94E-10	
Transmitter power output	correct	P/F	36.80	
Digital message		hours	P	
Home transmitter continuous operation during the lifetime test			65.48	
Home frequency		MHz	Start of Test	End of test taken as 65.48hrs.
Home peak power level		dBm	121.500501	
Home transmitter duty cycle		%	17.0	Note: current measurements comparisons for all modification states can be found in Annex B.
			96.90	
			121.499498	
			16.1	
			97.66	

Note: The manufacturer has declared a minimum operating lifetime duration of 24 hours plus 1 hour before PIE indication occurs. This represents the worst case operating lifetime duration conditions.



Parameters to be Measured	Range of Specification	Units	Test Results	Comments
11. Temperature Gradient (5°C/hr)				
Model: PLB3, S/N: TA000005, TUV Ref: TSR005 and Modification State 1				
Up Ramp				
Transmitted Frequency	C/S T.007	MHz	Min 406.031036102	Max 406.031109395
Nominal value	$\leq 2 \times 10^{-9}$	/100ms	4.50E-11	1.17E-09
Short-term stability	(-1 to +1) $\times 10^{-9}$	/min	-2.24E-10	2.08E-10
Medium-term stability – Slope ¹	(-2 to +2) $\times 10^{-9}$	/min	-4.05E-10	3.75E-10
Medium-term stability – Residual frequency variation	$\leq 3 \times 10^{-9}$		1.85E-10	1.28E-09
Transmitter power output	35 – 39	dBm	35.24	36.62
Digital message	correct	P/F	P	RLS Protocol
Down Ramp				
Transmitted Frequency	C/S T.007	MHz	Min 406.0310369	Max 406.0311089
Nominal value	$\leq 2 \times 10^{-9}$	/100ms	5.94E-11	1.26E-09
Short-term stability	(-1 to +1) $\times 10^{-9}$	/min	-4.56E-10	5.20E-10
Medium-term stability – Slope ¹	(-2 to +2) $\times 10^{-9}$	/min	-3.54E-10	4.10E-10
Medium-term stability – Residual frequency variation	$\leq 3 \times 10^{-9}$		2.42E-10	1.66E-09
Transmitter power output	35 – 39	dBm	35.00	36.61
Digital message	correct	P/F	P	RLS Protocol
12. Oscillator Aging				
Model: PLB3, S/N: TA000005, TUV Ref: TSR005 and Modification State 1				
5 year carrier nominal frequency variation	provided	Y / N	Y	See manufacturer document '5.(i.iv) RTR026A E6907LF MTS 5-year prediction.pdf'
MTS analysis (if applicable)	Must demonstrate compliance	P / F	Pass	
13. Protection Against Continuous Transmission				
Description	provided	Y / N	Y	See Annex A



Parameters to be Measured	Range of Specification	Units	Test Results	Comments
14. Satellite Qualitative Tests				
Model: PLB-450, S/N: TA000011, TUV Ref: TSR014 and Modification State 1 (SLP Configuration 7)				
Model: PLB-450, S/N: TA000011, TUV Ref: TSR014 and Modification State 2 (RLS Configuration 8)				
Model: PLB-450, S/N: TA000011, TUV Ref: TSR014 and Modification State 3 (SLP Configuration 8)				
Test Configuration	As per C/S T.007		Configuration	
15 Hex ID Decoded by LUT	correct	P / F	7 (SLP) 8 (RLS) 8 (SLP)	P P P
Doppler Location results with error ≤ 5km	≥ 80	%	83.33	100
RLM received within 15 mins	Confirm	P / F	N/A	P
Model: PLB3, S/N: TA000012, TUV Ref: TSR013 and Modification State 2				
Test Configuration	As per C/S T.007		Configuration	
15 Hex ID Decoded by LUT	correct	P / F	7 (RLS) 8 (RLS)	P P
Doppler Location results with error ≤ 5km	≥ 80	%	100	100
RLM received within 15 mins	Confirm	P / F	P	P
Result: Pass				