



**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

Chris Bland
Technician (Marine RF)

APPROVED BY

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 flotation device*		X
ELT Survival	On ground and above ground		
	On ground and above ground and floating in water		
ELT Auto Fixed	Fixed ELT with aircraft external antenna		
ELT(DT)	Distress Tracking ELT with aircraft external antenna		
ELT Auto Portable	In aircraft with an external antenna		
	On ground, above ground, or in a safety raft with an integrated antenna		
ELT Auto Deployable	Deployable ELT with attached antenna		
Other (specify)			

* 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	Tmin = -20 °C Tmax= 55 °C	
Temperature, at which minimum duration of continuous operation is expected (Submit C/S T.007 Section 5, part s, if applicable)	Tmin ✓ OR Other (°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):	N/A
	Nominal Voltage (V):	N/A
	Nominal Minimum Voltage (V):	N/A
	Nominal Maximum Voltage (V):	N/A
Is external power supply needed to energise the beacon or its ancillary devices in any of operational modes (N/A or Yes or No)	No	
Battery cell chemistry	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:	L91
	Cell Size:	50.5mm x 14.5mm dia
	Number of Cells in Battery Pack:	2
	Details of the battery pack electrical configuration:	2 series packs of 2 L91 cells in series (4 L91 cells in series)
Battery cell manufacturer	Energizer	
Battery pack manufacturer and part number	Battery Pack Manufacturer Name:	Ocean Signal Ltd
	Battery Pack Part Number:	901S-03316
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)	10	years



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	Optional GNSS Self-test Mode
Activated by a separate switch/ separate switch position (Yes or No)	Yes	Yes
Self-test/GNSS self-test mode switch automatically returns to normal position when released (Yes or No)	Yes	Yes
Self-test/ GNSS self-test activation can cause an operational mode transmission (Yes or No)	No	No
Results in transmission of a single self-test burst only, regardless of how long the self-test activation mechanism is applied (Yes or No)	Yes	Yes
Results of self-test / GNSS self-test are indicated by (provide details, e.g. Pass / Fail indicator light, strobe light, etc.)	Indicator LED / Strobe	Indicator LED / Strobe
The content of the encoded position data fields of the self-test message has default values	Yes	N/A
Performs an internal check and indicates that RF-power is being emitted at 406 MHz and 121.5 MHz, if beacon includes a 121.5 Hz homer (Yes or No)	Yes	No
Self-test results in transmission of a signal other than at 406 MHz (Yes & details or No)	Yes, 121.5MHz for 1sec, AIS	Yes, AIS
Self-test can be activated directly at beacon (Yes or No)	Yes	Yes
List of Items checked by self-test	406 Power and frequency lock, AIS Synth, AIS Power and frequency lock, 121.5 Power, Battery Status	GNSS *
		*(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).
Self-test/ GNSS self-test 406 MHz burst duration (440 or 520 ms)	520ms	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	



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	
Standard Location Protocol	National (Short Message Format)	
	National (Long Message Format)	
	EPIRB with MMSI	X
	EPIRB with Serial Number	
	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(DT) Location Protocol	ELT with Serial Number	
	ELT with Aircraft Operator and Serial Number	
	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



User Location Protocol	Maritime with MMSI		
	Maritime with Radio Call Sign		
	EPIRB Float Free with Serial Number		
	EPIRB Non Float Free with Serial Number		
	Radio Call Sign		
	Aviation		
	ELT with Serial Number		
	ELT with Aircraft Operator and Serial Number		
	ELT with Aircraft 24-bit Address		
	PLB with Serial Number		
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 $\pm$ 2dBm	Yes
	243.0 MHz	N/A	No
	AIS	31.5 $\pm$ 0.5dBm	Yes
	Other (MHz)		
	N/A	N/A	No
	Description:	<< Description >>	
	97 (121.5MHz)	%	
	37 (121.5MHz)	%	
	Yes		
>1	cd		
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	



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.	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.		
	Beacon includes automatic activation mechanism (Yes or No). Specify type of automatic beacon activation mechanism	Yes / No :	No
	Beacon includes a voice-transceiver (Yes or No), and if Yes specify: Voice transmitter nominal output power Voice transmitter operating frequencies - provides prevention against continuous operation of voice transmitter (Yes or No), and if Yes specify: - maximum continuous voice-transmission operation ("time-out timer") - maximum cumulative transmit-mode on-time ("On time")	Description:	N/A
		Yes / No :	No
		If Yes, specify: (dBm)	N/A
		If Yes, specify: (MHz)	N/A
		Yes / No :	N/A
		"Time-out timer" (minutes):	N/A
		On time (hours : minutes):	N/A
	Beacon includes features and functions not listed above, related or non-related to 406 MHz (Yes or No). List features and use a separate sheet if insufficient space	Yes	
	Beacon model hardware part number (P/N) and version	Description:	Near-Field Communication (NFC)
	Beacon model firmware P/N, version, date of issue/releases	900S-03356 Issue 01.00 (PLB3, rescueME PLB3) , 900S-03767 Issue 01.00 (PLB-450, ResQLink AIS)	
	Beacon model software P/N, version, date of issue/releases	500S-03492 Issue 01.00	
	Beacon model printed circuit board P/N and version	N/A	
	Beacon model multiple programmable options, except message coding protocols (Yes/No)	101S-02834 Issue 01.00	
		No	
		N/A	
	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)	Yes	



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:

A handwritten signature in black ink, appearing to read 'M. Hardy', written over a horizontal line.

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.

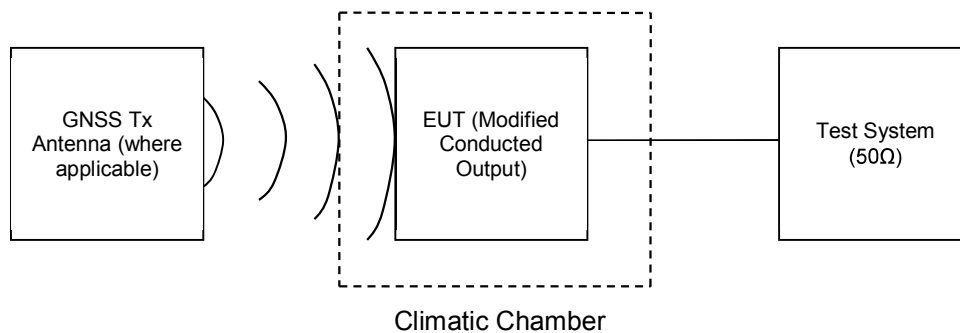
The second and third EUTs were fully packaged beacons, similar to the proposed production beacons equipped with their proper antenna. The first of these EUTs (TA000011 / TSR014) was the PLB-450 variant and was used to perform Antenna Characteristics, Satellite Qualitative and Position Acquisition Time 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).

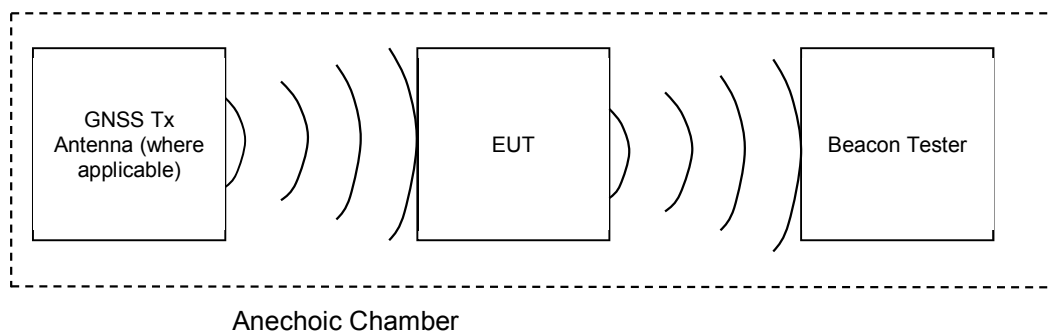
Manufacturer Reference	TUV SUD Reference	Configuration	Brand (colour)
TA000005	TSR005	Conducted	Ocean Signal PLB3 (yellow)
TA000011	TSR014	Radiated	ACR PLB-450 (chartreuse)
TA000012	TSR013	Radiated	Ocean Signal PLB3 (yellow)
TA000003	TSR026	Radiated with NMEA data output	Ocean Signal PLB3 (yellow)

System Configurations

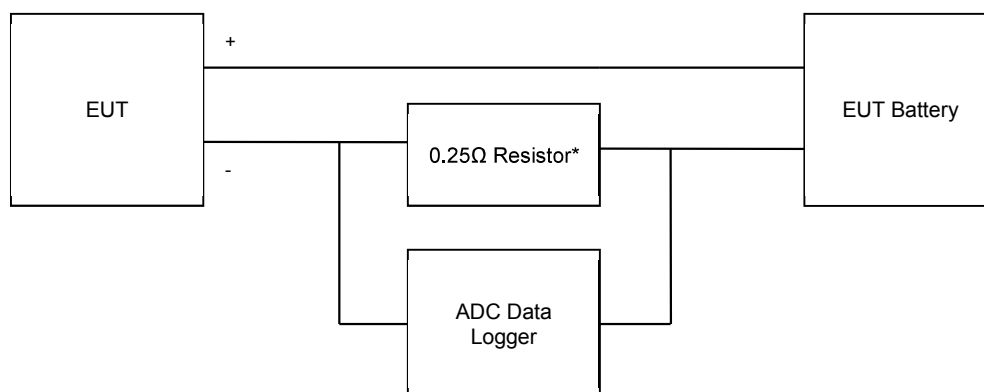
Conducted Laboratory Tests



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
- 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	Ref email dated: 13 Sept 2021 15:14 but as modified 13 Sept 2021 16:19 Subject: RE: Pre-applications: PA20-09: PLB3/PLB-450 - TUV Type Approval Test Status and Proposed Firmware Update	A change from MS0 to MS1 was made following identification of an error with the decoding of the RLM message in test mode. Discussions with the C/S Secretariat indicated the scope of testing as per the Additional Testing Requirement column. In addition, the two EUTs models were discussed, and it was agreed to complete the following additional tests on the alternate model: Satellite Qualitative Tests in all applicable configurations.
- 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)	Ref email dated: 07 Oct 2021 21:46 RE: Pre-applications: PA20-09: PLB3/PLB-450 - Type Approval Testing - Firmware Change Required	A change from MS1 to MS2 was made following identification of errors with the Testing of Operator Controls feature. Discussions with the C/S Secretariat indicated the scope of testing as per the Additional Testing Requirement column. Refer to Annex B for Modification State Comparison data.
- Functional tests at ambient temperature (A.2.1). - Satellite Qualification in one configuration (A.2.5) - Worst case current measurements comparisons	Ref email dated: 12 April 2022 14:29 RE: Plb3 worksheet	A change from MS2 to MS3 was made following identification of errors in the AIS stack, which caused an incorrect True Heading reading. Discussion with the C/S Secretariate indicated the scope of testing as per the Additional Testing Requirement column. Refer to Annex B for Modification State Comparison data.

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 (-20°C)	Tamb (+21°C)	Tmax (+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) 35 – 39 (minimum)	dBm	36.93 36.69 0.42 0.29 -31.74 -32.12	36.57 36.44 0.34 0.33 -26.85 -41.93	35.98 35.92 0.45 0.43 -32.89 -33.37	
Power output rise time	(maximum) < 5 (minimum)	ms				
Power output 1ms before burst	(maximum) < -10 (minimum)	dBm				
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	15 bits "1"	P	P	P	
Frame sync	16 - 24	"000101111"	P	P	P	
Format flag	25	1 bit	1	1	1	
Protocol flag	26	1 bit	0	0	0	
Identification / position data	27 - 85	59 bits	P / F	P	P	
BCH code	86 -106	21 bits	P / F	P	P	
Emerg. Code/nat. use/supplem. Data	107 - 112	6 bits	111000	111000	111000	
Additional data / BCH (if applicable)	112 - 144	32 bits	P / F	P	P	
Position Error (if applicable)		< 5	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 ≤ T _{Ravg} ≤ 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 ≤ T _{Rmin} ≤ 48.0	seconds	48.001*	47.990	48.001*	
Maximum T _R	52.0 ≤ T _{Rmax} ≤ 52.5	seconds	52.10	52.11	52.29	
Standard deviation	0.5 - 2.0	seconds	1.41	1.40	1.46	
Bit rate						
Minimum fb	≥ 396	bits/sec	399.98	399.91	399.97	
Maximum fb	≤ 404	bits/sec	399.96	400.00	399.98	
Total transmission time						
Short message	(maximum)		N/A	N/A	N/A	
	(minimum)	ms	N/A	N/A	N/A	
Long message	(maximum)		520.30	519.63	520.16	
	(minimum)	ms	520.15	519.61	520.10	
Unmodulated carrier						
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	
Symmetry measurement	≤ 0.05		0.0269	0.0224	0.0274	
*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.						
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) (minimum)		406.0311176	406.0310760	406.0310107	
Short-term stability	≤ 2x10 ⁻⁹	/100ms	1.35E-9	5.83E-10	2.83E-10	
	(maximum) (minimum)		1.31E-9	5.49E-10	2.31E-10	
Medium-term stability – Slope	(-1 to +1)x10 ⁻⁹	/minutes	1.38E-10	-1.66E-10	3.43E-10	
	(maximum) (minimum)		-1.04E-10	-3.33E-10	1.48E-10	
Medium-term stability – Residual frequency variation	≤ 3x10 ⁻⁹		1.13E-9	7.69E-10	1.27E-9	
	(maximum) (minimum)		9.46E-10	3.62E-10	6.92E-10	
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	



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)	C/S T.001	406.0311097 406.0311085	406.0310508 406.0310499	406.0310330 406.0310317	
Modulation rise time	(maximum) (minimum)	50-250	213.4 182.3	206.4 180.3	203.3 177.3	
Modulation fall time	(maximum) (minimum)	50-250	229.7 203.6	222.7 198.7	220.6 196.6	
Modulation phase deviation: positive	(maximum) (minimum)	+ (1.0 to 1.2) + (1.0 to 1.2)	1.1429 1.0064	1.1559 1.0354	1.1913 1.0414	
Modulation phase deviation: negative	(maximum) (minimum)	- (1.0 to 1.2) - (1.0 to 1.2)	-1.1160 -0.9829*	-1.1682 -1.0326	-1.1877 -1.0433	
Modulation symmetry measurement		≤ 0.05	0.0274	0.0270	0.0273	
Digital Message		correct	P	P	P	
						*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. RLS Protocol



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						
Model: PLB3, S/N: TA000005, TUV Ref: TSR005 and Modification State 3 (Ambient Only) – RLS Protocol						
Model: PLB3, S/N: TA000005, TUV Ref: TSR005 and Modification State 1 (-20°C) – RLS Protocol						
Model: PLB3, S/N: 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			
Design data on protection against repetitive self-test mode transmissions	provided	Y / N	Y			
Single burst verification	one burst	P / F	P	P	P	
Provides for 15 Hex ID	correct	P / F	P	P	P	
121.5 MHz RF power (if applicable)	verify that RF power emitted	P / F	P	P	P	
406 MHz power	verify that RF power emitted	P / F	P	P	P	
Distinct indication of Self-Test	provided	Y / N	Y	Y	Y	Manufacturer specified value: 15.6 seconds
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			
Maximum duration of Self-Test mode	≤ maximum duration of Self-Test	sec	15.6	15.6	15.6	
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 (-20°C)	Tamb (+21°C)	Tmax (+55°C)	
8 (b). GNSS Self-Test Mode (if applicable)						
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 1 (-20°C and +55°C)						
Frame sync	011010000	P / F	P	P	P	See Annex A
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		
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	
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		
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		
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		
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			Max	
Short-term stability	C/S T.001	MHz	406.0310727	
Medium-term stability – Slope	$\leq 2 \times 10^{-9}$	/100ms	6.42E-10	
Medium-term stability – Residual frequency variation	$(-2 \text{ to } +2) \times 10^{-9}$	/min	3.54E-11	
Transmitter power output	$\leq 3 \times 10^{-9}$		5.86E-10	
Digital message	35 - 39	dBm	36.69	
	correct	P/F	P	
				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).
Duration	>25 ^(see note)	Hours	46.59 Hours at T _{min} = -20°C	EUT self terminated.
Effective Operating Lifetime 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.
Transmitted Frequency			Min	
Nominal value	C/S T.001	MHz	406.0311104	
Short-term stability	≤ 2x10 ⁻⁹	/100ms	1.10E-09	
Medium-term stability – Slope	(-1 to +1)x10 ⁻⁹	/min	-1.34E-10	
Medium-term stability – Residual frequency variation	≤ 3x10 ⁻⁹		5.94E-10	
Transmitter power output	35 - 39 correct	dBm	36.80	
Digital message		P/F	P	RLS Protocol
Home transmitter continuous operation during the lifetime test		hours	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 ≤ 2x10 ⁻⁹ (-1 to +1)x10 ⁻⁹ (-2 to +2)x10 ⁻⁹ ≤ 3x10 ⁻⁹ 35 – 39 correct	MHz	Min	Max	Data for points A to B and C+15 to D Data for points B to C+15 min RLS Protocol
Nominal value			406.031036102	406.031109395	
Short-term stability		/100ms	4.50E-11	1.17E-09	
Medium-term stability – Slope ¹		/min	-2.24E-10	2.08E-10	
Medium-term stability – Residual frequency variation		/min	-4.05E-10	3.75E-10	
Transmitter power output		dBm	1.85E-10	1.28E-09	
Digital message		P/F	35.24	36.62	
Down Ramp					
Transmitted Frequency	C/S T.007 ≤ 2x10 ⁻⁹ (-1 to +1)x10 ⁻⁹ (-2 to +2)x10 ⁻⁹ ≤ 3x10 ⁻⁹ 35 – 39 correct	MHz	Min	Max	Data for points C to D, E + 15 min to F Data for points D to E+15 min RLS Protocol
Nominal value			406.0310369	406.0311089	
Short-term stability		/100ms	5.94E-11	1.26E-09	
Medium-term stability – Slope ¹		/min	-4.56E-10	5.20E-10	
Medium-term stability – Residual frequency variation		/min	-3.54E-10	4.10E-10	
Transmitter power output		dBm	2.42E-10	1.66E-09	
Digital message		P/F	35.00	36.61	
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 Doppler Location results with error ≤ 5km RLM received within 15 mins	correct	P / F	7 (SLP)	8 (RLS)	8 (SLP)	
	≥ 80	%	P	P	P	
	Confirm	P / F	83.33	100	100	
			N/A	P	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 Doppler Location results with error ≤ 5km RLM received within 15 mins	correct	P / F	7 (RLS)	8 (RLS)		
	≥ 80	%	P	P	P	
	Confirm	P / F	100	100	100	
			P	P	P	

Result: Pass