



**Add value.
Inspire trust.**

Report On

Emergency Beacons Testing of the
ACR Electronics Inc
RLB-44
In accordance with Cospas-Sarsat T.007

Document 75953445 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
ACR Electronics Inc
RLB-44

Document 75953445 Report 01 Issue 5

August 2022

APPLICANT / MANUFACTURER Ocean Signal Limited
Unit 4
Ocivan Way
Margate
CT9 4NN

MANUFACTURER ACR Electronics Inc
5757 Ravenswood Drive
Fort Lauderdale
FL 33312
USA

PREPARED BY

A handwritten signature in black ink, appearing to read 'MS'.

Matt Sellers
Apprentice (RF)

APPROVED BY

A handwritten signature in black ink, appearing to read '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	15
1.4	Test Locations	20
1.5	Modifications.....	21
1.6	Report Modification Record	23
2	TEST DETAILS	24
2.1	Power Output.....	41
2.2	Digital Message	43
2.3	Modulation	48
2.4	406 MHz Transmitted Frequency	52
2.5	Spurious Emissions into 50 Ohms.....	59
2.6	406 MHz VSWR Check	63
2.7	Self-Test Modes.....	70
2.8	Thermal Shock.....	84
2.9	Satellite Qualitative Tests	90
2.10	Operating Lifetime at Minimum Temperature	95
2.11	Frequency Stability Test with Temperature Gradient	120
2.12	Navigation System Test.....	125
2.13	Beacon Antenna Test	131
2.14	Beacon Coding Software.....	134
2.15	RLM Reception Verification	135
2.16	Testing of Operator Controls	143
3	TEST EQUIPMENT USED	144
3.1	Test Equipment.....	145
3.2	Measurement Uncertainty	148
4	PHOTOGRAPHS.....	149
4.1	Photographs of Equipment Under Test (EUT)	150
5	ACCREDITATION, DISCLAIMERS AND COPYRIGHT.....	160
5.1	Accreditation, Disclaimers and Copyright.....	161
ANNEX A	Additional Test of the GNSS Receiver Update Interval.....	A.2



SECTION 1

REPORT SUMMARY

Emergency Beacons Testing of the
ACR Electronics Inc
RLB-44



1.1 INTRODUCTION

The information contained in this report is intended to show verification of the ACR Electronics Inc RLB-44 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.
Applicant	Ocean Signal Limited
Manufacturer	ACR Electronics Inc
Model Number(s)	RLB-44
Serial Number(s)	TA000003 TA000006 TA000007 TA000008 TA000022
Number of Samples Tested	5
Test Specification/Issue/Date	Cospas-Sarsat T.007 Issue 5 Rev 7 June 2021
Date of Receipt of Test Samples	6 January 2022
Order Number	PO13429
Date	16 September 2021
Start of Test	07 January 2022
Finish of Test	04 May 2022
Name of Engineer(s)	M Sellers P Adams
Related Documents	Cospas-Sarsat T.001 Issue 4 Revision 8 June 2021 Cospas-Sarsat T.IP (TCXO) Issue 1 Revision 5 October 2013



1.2 APPLICATION FORM

G.1 - Beacon Manufacturer and Beacon Model	
Beacon Manufacturer	Ocean Signal Ltd, ACR Electronics Inc.
Beacon Manufacturer's Address	Ocean Signal Ltd, Unit 4 Ocivan Way, Margate, Kent, CT9 4NN, UK
Beacon Model Name	ACR Electronics Inc, 5757 Ravenswood Road, Fort Lauderdale, FL 33312, USA
Additional Beacon Model Names	RLB-44, EPIRB3 Pro, EPIRB3 GlobalFix V5, SafeSea EPIRB3 Pro, rescueME EPIRB3

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	X
EPIRB Non-Float Free (automatic and manual activation)	Floating in water or on deck or in a safety raft	X
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*	
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)	N/A	

* 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 Tmin = -20 °C
Temperature, at which minimum duration of continuous operation is expected (Submit C/S T.007 Section 5, part s, if applicable)	OR Other (-20°C) N/A
Manufacturer-declared Minimum Operating Lifetime*	24 hours, or 48 hours, or 168 hours, or Other hours Other hours, (specify)
* this value is specified by National Administrations or International Organisations	No Yes 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	Lithium Iron Disulphide
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: 6 Details of the battery pack electrical configuration: 3 series packs of 2 cells in series (6 cells in series)
Battery cell manufacturer	Energizer
Battery pack manufacturer and part number	Battery Pack Manufacturer Name: Ocean Signal Ltd and/or ACR Electronics Inc Battery Pack Part Number: 901S-03925
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)	10.5 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 and/or ACR Electronics Inc
	OEM Model Name: N/A
	OEM Part Number: N/A
Antenna part name and part number (OEM, if applicable, and beacon manufacturer's)	Beacon Manufacturer's Model Name: 130S-03877(RLB-44) / 130S-03273(EPIRB3 Pro) / 130S-01404(EPIRB3)
	Beacon Manufacturer's Part Number: 130S-03877(RLB-44) / 130S-03273(EPIRB3 Pro) / 130S-01404(EPIRB3)
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)	3:57.5 to 15:00 minutes:seconds
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	Yes
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
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 Freq Generation & RF Power, AIS Freq Generation & RF Power, 121.5 RF Power, Battery Status, GNSS Module status</p> <p>GNSS, AIS*, 406*</p> <p>*(The GNSS self-test is limited to checking operation of the internal GNSS receiver; if a fix is acquired during the test the beacon shall encode the position and perform a burst of 8 AIS test transmissions followed by a 406MHz test 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
Maximum duration of a self-test mode, sec	16
	520ms
	1
	16




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)	Test key only	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
Standard Location Protocol	EPIRB with Serial Number	X
	ELT with 24-bit Address	
	ELT with Aircraft Operator Designator	
	ELT with Serial Number	
	PLB with Serial Number	
National Location Protocol	National Location: EPIRB	
	National Location: ELT	



Other Declarations	Declared Value	Yes / No														
Beacon includes a homer transmitter(s) (Yes or No)	Yes	Yes / No														
- homer transmitter(s) frequency and power	<table border="1"> <thead> <tr> <th data-bbox="408 734 435 1218">Frequency</th> <th data-bbox="408 235 435 734">Power (dBm)</th> </tr> </thead> <tbody> <tr> <td data-bbox="448 734 475 1218">121.5 MHz</td> <td data-bbox="448 235 475 734">16dBm ±2dBm</td> </tr> <tr> <td data-bbox="478 734 505 1218">243.0 MHz</td> <td data-bbox="478 235 505 734">N/A</td> </tr> <tr> <td data-bbox="509 734 536 1218">AIS</td> <td data-bbox="509 235 536 734">31.5 ±0.5dBm</td> </tr> <tr> <td data-bbox="539 734 566 1218">Other (MHz)</td> <td data-bbox="539 235 566 734"></td> </tr> <tr> <td data-bbox="569 734 596 1218">N/A</td> <td data-bbox="569 235 596 734">N/A</td> </tr> <tr> <td data-bbox="600 734 627 1218">Description:</td> <td data-bbox="600 235 627 734">N/A</td> </tr> </tbody> </table>	Frequency	Power (dBm)	121.5 MHz	16dBm ±2dBm	243.0 MHz	N/A	AIS	31.5 ±0.5dBm	Other (MHz)		N/A	N/A	Description:	N/A	Yes Yes No Yes No
Frequency	Power (dBm)															
121.5 MHz	16dBm ±2dBm															
243.0 MHz	N/A															
AIS	31.5 ±0.5dBm															
Other (MHz)																
N/A	N/A															
Description:	N/A															
homer transmitter(s) duty cycle	50 - 98 (121.5MHz)	%														
duty cycle of homer swept tone	35 (121.5MHz)	%														
Beacon includes a high intensity flashing light (e.g. Strobe)	Yes															
- light intensity	>0.5	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															
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.	Yes, non-visible IR strobe															
Beacon includes automatic activation mechanism (Yes or No). Specify type of automatic beacon activation mechanism	Yes / No :	Yes														
Beacon includes a voice-transceiver (Yes or No), and if Yes specify:	Description:	Water contacts														
Voice transmitter nominal output power	Yes / No :	No														
Voice transmitter operating frequencies	If Yes, specify: (dBm)	N/A														
- provides prevention against continuous operation of voice transmitter (Yes or No), and if Yes specify:	If Yes, specify: (MHz)	N/A														
- maximum continuous voice-transmission operation ("time-out timer")	Yes / No :	N/A														
- maximum cumulative transmit-mode on-time ("On time")	"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	Near-Field Communication (NFC)														



Beacon model hardware part number (P/N) and version	900S-03858 Issue 01.00 (RLB-44, GlobalFix V5), 900S-03887 Issue 01.00 (EPIRB3 Pro, SafeSea EPIRB3 Pro), 900S-03886 Issue 01.00 (EPIRB3, rescueME EPIRB3)
Beacon model firmware P/N, version, date of issue/releases	500S-03885 Issue 00.03.00, Release date 07/04/2022 Tested Version. Production version Issue 01.00 01/06/2022
Beacon model software P/N, version, date of issue/releases	N/A
Beacon model printed circuit board P/N and version	101S-03721 Issue 01.00
Beacon model multiple programmable options, except message coding protocols (Yes/No)	No
Beacon model multiple programmable options, except message coding protocols (Yes/No)	If Yes, List all programmable options associated with this type-approval application:
Known non-compliances with C/S T.001 requirements (Yes or No). If Yes, provide details (Submit C/S T.007 Section 5, part t, if applicable)	No
Beacon Manufacturer Point of Contact (POC) for this Type Approval application:	
Name and Job Title:	Mark Newton / Approvals Manager
Phone:	+44 1843 808028
E-mail:	mark.newton@oceansignal.com
Dated(*)	28-07-2022
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: 06 January 2022

Applicable C/S Standards:

Document	Issue	Revision	Date
C/S T.001	4	8	June 2021
C/S T.007	5	7	June 2021
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 Clause A.2.7 of Cospas Sarsat T.007, the minimum update interval during A.3.8.3 testing was found to be outside of the limit requirement. Discussions between the manufacturer and the Secretariate concluded that this could be considered acceptable. Refer to manufacturer document 921S-04094 Cospas-Sarsat Beacon Update rate.



Deviations:


For Clause A.2.3 of Cospas Sarsat T.007, the battery that was used for testing was discharged more than the required amount. This was performed to comply with RTCM Standard 11000.5.

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.

For A.3.8.3 an additional test was carried out with a Manufacturer supplied scenario with constant motion (refer to Annex A Additional Test of the GNSS Receiver Update Interval) to verify the Manufacturer's declared encoded position update rate. Refer also to Manufacturer supplied document 921S-04094 Issue 01.40 Cospas-Sarsat Beacon Update rate.

Notes:

None.

Signed:	
Name:	<u>Martin Hardy</u>
Position Held:	<u>Authorised Signatory</u>
Date:	<u>02 August 2022</u>

1.3 PRODUCT INFORMATION

1.3.1 Technical Description

The Equipment Under Test (EUT) was an ACR Electronics Inc RLB-44 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). Three EUT's were configured so that the antenna port was connected to the 50 Ω test system using a coaxial cable (TA000003, TA000006, TA000022). 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.

Another EUT was a fully packaged beacon, similar to the proposed production beacons equipped with its proper antenna (TA000007). This EUT was used to perform Antenna Characteristics, Satellite Qualitative and Position Acquisition Time and Position Accuracy. The test configuration for these tests is a function of the beacon type and the operational environments supported by the beacon, as declared by the manufacturer.

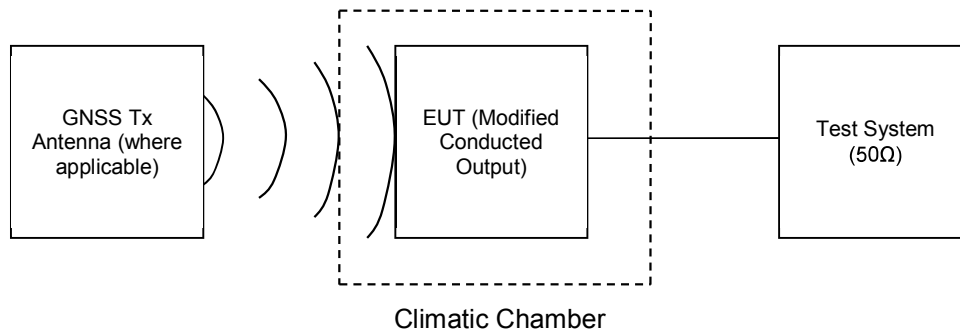


The final EUT was a fully packaged beacon with an additional NMEA data output which enabled monitoring of the GNSS Receiver for the RLM Reception Verification tests (TA000008).

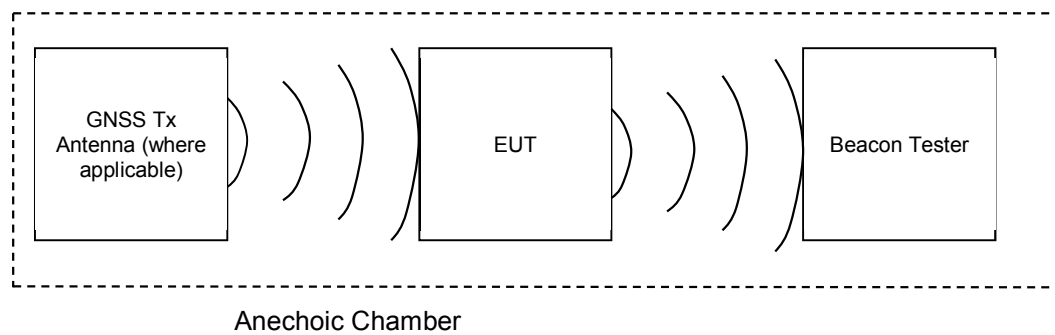
Manufacturer Reference	TUV SUD Reference	Configuration
TA000003	TSR1	Conducted
TA000006	TSR2	Conducted
TA000007	TSR4	Radiated
TA000008	TSR5	Radiated with NMEA data output
TA000022	TSR15	Conducted

System Configurations

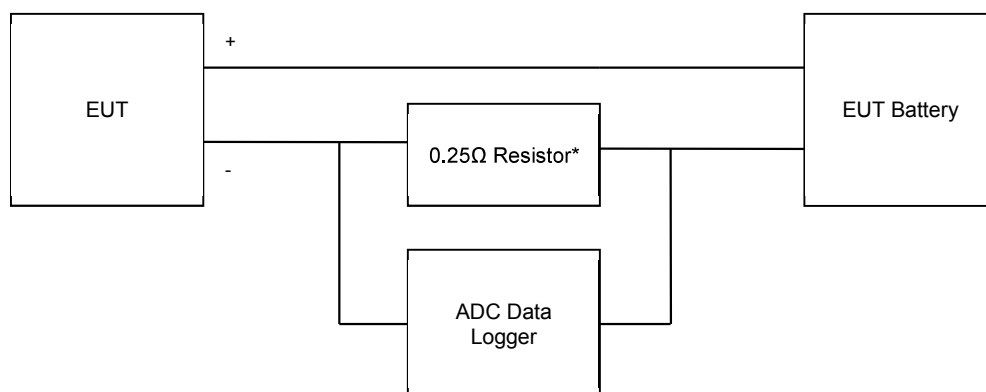
Conducted Laboratory Tests



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 2.10) concluded that the 'worst case' (highest current) operating mode of the EUT was B13 – ON at EUT, RLS Protocol, No Ancillaries, GNSS in normal operating duty cycle.

All tests were carried out in this mode.

The EUT is fitted with an internal GNSS receiver. From cold start, without GNSS signal data present, the duty cycle of the receiver is as described in the manufacturer information (T.007: 5.(n-i) GNSS Operation cycle and its phases.pdf). 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 power alignment comparison of conducted test samples is presented below. Measurements were carried out at ambient temperature over a 15 minute period following a 15 minute warm up. The comparison was carried out with all test samples in Modification State 1.

Test Date: 23 February 2022, 24 February 2022 and 06 April 2022.

406MHz

Sample Number	Average Power Output (dBm)	Maximum Difference (dB)*
TSR1 – TA000003	36.14	0.13
TSR2 – TA000006	36.20	
TSR15 – TA000022	36.07	

* The overall maximum difference was 0.13dB, between samples TSR1 – TA000003, sample TSR2 – TA000006 and sample TSR15 – TA000022.

121.5 MHz

Sample Number	Peak Power Output (dBm)	Maximum Difference (dB)*
TSR1 – TA000003	17.99	0.2
TSR2 – TA000006	17.79	
TSR15 – TA000022	17.89	

* The overall maximum difference was 0.2dB, between samples TSR1 – TA000003, sample TSR2 – TA000006 and sample TSR15 – TA000022.

162 MHz

Sample Number	Peak Power Output (dBm)	Maximum Difference (dB)*
TSR1 – TA000003	32.04	0.29
TSR2 – TA000006	32.33	
TSR15 – TA000022	32.13	

* The overall maximum difference was 0.29dB, between samples TSR1 – TA000003, sample TSR2 – TA000006 and sample TSR15 – TA000022.



1.3.3 Modes of Operation

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

Off/Standby Mode

- No apparent activity

NFC Mode

- Interrogate the NFC device with an NFC field

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 'burst')

Operating

- On button pressed
- 121.5 Homer active and offset
- AIS active
- GNSS operating in normal duty cycle
- No navigation data applied (unless otherwise stated)

All modes

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

- Water contacts

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



1.4 TEST LOCATIONS

Satellite Qualitative/Navigation test A.3.8.2.2: 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	N/A	N/A	As supplied by manufacturer. Hardware: 01.00 Firmware: 00.01.00 Software: N/A
1	22/02/2022	Update to fix GNSS Timings via factory NVM settings and AIS Timings (self test burst) via factory NVM settings	Hardware: 01.00 Firmware: 00.01.00 Software: N/A
2	07/04/2022	Change to AIS stack for True Heading parameter	Hardware: 01.00 Firmware: 00.03.00 Software: 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
See Details column.	N/A	<p>A change from MS0 to MS1 was made following identification of an update to the factory NVM settings for the GNSS Timings and AIS Timings in self test only.</p> <p>The only test carried out in Modification State 0 was the Antenna characteristics test. The Manufacturer confirmed that the factory NVM settings change would have no impact on the outcome of this Antenna Characteristics test. Whilst the change was recorded as a modification state for the purpose of this document, no firmware or hardware was changed and therefore contact with the Secretariate was not made.</p>
<ul style="list-style-type: none"> • Functional tests at ambient temperature (A.2.1). • Satellite Qualification in one configuration (A.2.5) <p>Worst case current measurements comparisons</p>	<p>Ref email dated: 12 April 2022 14:29</p> <p>RE: Plb3 worksheet</p>	<p>A change from MS1 to MS2 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>NOTE: this firmware issue was originally identified within another Ocean Signal product. The case was discussed, and the logic of repeat testing applied to this EUT/project.</p> <p>Repeat current measurements in MS2 were not carried out on this model. They were carried out on the EPIRB3 Pro variant presented with comparison analysis – refer to TUV SUD document 75952867 Report 01.</p>



1.6 REPORT MODIFICATION RECORD

Issue 1 – First Issue.

Issue 2 – Revisions in line with Cospas Sarsat worksheet: 2022-11_Worksheet-01_FTA_RLB-44_09_JUL_2022. Modifications include: updated bit rate for the summary table of Section 2 in relation to RLS requirements. Results for the PIE test were relocated to the Self-Test area of Section 2.7. Reference to Annex B (modification state comparison data) removed from table detailing scope of additional testing (section 1.5). Reference to manufacturer GNSS duty cycle documentation revised in section 1.3 (Further Information section). Revised annex G as supplied by Manufacturer.

Issue 3 – Corrections to firmware version in section 1.5.

Issue 4 – Revised application form as supplied by Manufacturer (WS02).

Issue 5 – Reference to Manufacturer report for RLS GNSS Satellite Tracking added (summary table section 18 and report section 2.15).



SECTION 2

TEST DETAILS

Emergency Beacons Testing of the
ACR Electronics Inc
RLB-44



TEST RESULTS 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: RLB-44, S/N: TA000003, TUV Ref: TSR1 and Modification State 1						
Transmitter power output (maximum) (minimum)	35 - 39	dBm	36.34 36.26	35.94 35.66	35.35 35.30	
Power output rise time (maximum) (minimum)	< 5	ms	0.48 0.47	0.54 0.50	0.52 0.52	
Power output 1ms before burst (maximum) (minimum)	< -10	dBm	-30.54 -30.79	-31.83 -32.28	-32.18 -32.18	
2. Digital Message Coding						
Model: RLB-44, S/N: TA000003, TUV Ref: TSR1 and Modification State 1						
Bit Sync	15 bits "1"	P / F	P	P	P	P
Frame sync	16 - 24	P / F	P	P	P	P
Format flag	25	bit value	1	1	1	1
Protocol flag	26	bit value	0	0	0	0
Identification / position data	27 - 85	P / F	P	P	P	P
BCH code	86 -106	P / F	P	P	P	P
Emerg. Code/nat. use/supplem. Data	107 - 112	bit value	111000	111000	111000	111000
Additional data / BCH (if applicable)	112 - 144	P / F	P	P	P	P
Position Error (if applicable)	< 5	km	N/A	N/A	N/A	N/A
Result: Pass						



Parameters to be Measured	Range of Specification	Units	Test Results			Comments
			Tmin (-20°C)	Tamb (+21°C)	Tmax (+55°C)	
3. Digital Message Generator						
Model: RLB-44, S/N: TA000003, TUV Ref: TSR1 and Modification State 1						
Repetition rate, T_R :						
Average T_R	$48.5 \leq T_{Ravg} \leq 51.5$	seconds	49.970	50.000	50.093	
Minimum T_R	$47.5 \leq T_{Rmin} \leq 48.0$	seconds	47.531	47.516	47.890	
Maximum T_R	$52.0 \leq T_{Rmax} \leq 52.5$	seconds	52.205	52.281	52.219	
Standard deviation	$0.5 - 2.0$	seconds	1.69	1.74	1.66	
Bit rate						
Minimum fb	≥ 399.6	bits/sec	399.95	399.95	399.95	
Maximum fb	≤ 400.4	bits/sec	399.97	399.97	399.97	
Total transmission time						
Short message	(maximum) $435.6 - 444.4$ (minimum)	ms	N/A	N/A	N/A	
Long message	(maximum) $514.8 - 525.2$ (minimum)	ms	N/A	N/A	N/A	
Unmodulated carrier						
Minimum T1	≥ 158.4	ms	160.65	160.63	160.61	
Maximum T1	≤ 161.6	ms	160.74	160.72	160.72	
First burst delay	≥ 47.5	seconds	52	51	51	
Result: Pass						



Parameters to be Measured	Range of Specification	Units	Test Results			Comments
			Tmin	Tamb	Tmax	
			(-20°C)	(+21°C)	(+55°C)	
4. Modulation						
Model: RLB-44, S/N: TA000003, TUV Ref: TSR1 and Modification State 1						
Biphase-L		P / F	P	P	P	
Rise time	(maximum) 50 - 250	µs	121.4	124.4	121.4	
	(minimum) 50 - 250	µs	109.3	107.3	109.4	
Fall time	(maximum) 50 - 250	µs	163.7	158.7	159.6	
	(minimum) 50 - 250	µs	146.7	143.7	144.7	
Phase deviation: positive	(maximum) +(1.0 to 1.2)	radians	1.1429	1.1663	1.1882	
	(minimum) +(1.0 to 1.2)	radians	1.0156	1.0327	1.0705	
Phase deviation: negative	(maximum) -(1.0 to 1.2)	radians	-1.1438	-1.1715	-1.1949	
	(minimum) -(1.0 to 1.2)	radians	-1.0055	-1.0424	-1.0618	
Symmetry measurement	≤ 0.05	radians	0.0282	0.0290	0.0278	
5. 406 MHz Transmitted Frequency						
Model: RLB-44, S/N: TA000003, TUV Ref: TSR1 and Modification State 1						
Nominal Value	(maximum) C/S T.001	MHz	406.0310867	406.0310199	406.0310414	
	(minimum)		406.0310858	460.0310192	406.0310412	
Short-term stability	(maximum) ≤ 2x10 ⁻⁹	/100ms	10.815E-10	14.902E-11	34.499E-11	
	(minimum)		10.627E-10	12.986E-11	31.309E-11	
Medium-term stability – Slope	(maximum) (-1 to +1)x10 ⁻⁹	/minutes	30.932E-11	18.420E-11	84.510E-12	
	(minimum)		-27.199E-11	19.532E-12	-21.100E-11	
Medium-term stability – Residual frequency variation	(maximum) ≤ 3x10 ⁻⁹		14.979E-10	59.933E-11	10.959E-10	
	(minimum)		97.356E-11	34.343E-11	79.244E-11	
6. Spurious Emissions into 50ohms						
Model: RLB-44, S/N: TA000003, TUV Ref: TSR1 and Modification State 1						
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: RLB-44, S/N: TA000003, TUV Ref: TSR1 and Modification State 1						
Nominal Value	(maximum) (minimum)	C/S T.001	406.0310809 406.0310728	406.0310195 406.0310189	406.0310420 406.0310415	
Modulation rise time	(maximum) (minimum)	50-250	122.3 109.4	124.3 107.3	122.3 108.3	
Modulation fall time	(maximum) (minimum)	50-250	162.7 146.7	160.7 145.7	158.6 144.7	
Modulation phase deviation: positive	(maximum) (minimum)	+ (1.0 to 1.2)	1.1426 1.0049	1.1622 1.0280	1.1934 1.0610	
Modulation phase deviation: negative	(maximum) (minimum)	- (1.0 to 1.2)	-1.1643 -1.0051	-1.1754 -1.0515	-1.1979 -1.0504	
Modulation symmetry measurement	≤ 0.05		0.0282	0.0278	0.0278	
Digital Message	correct		P	P	P	
Result: Pass						



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: RLB-44, S/N: TA000003, TUV Ref: TSR1 and Modification State 1						
Frame sync	011010000	P / F	P	P	P	
Format flag	1 / 0	bit value	1	1	1	
Single radiated burst	≤440 / 520 (±1%)	ms	520.093	520.34	520.098	
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	15	15	Manufacturer declared value: 16
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: RLB-44, S/N: TA000003, TUV Ref: TSR1 and Modification State 1						
Frame sync	011010000	P / F	P	P	P	
Format flag	1 / 0	bit value	1	1	1	
Radiated burst duration	≤ 520 (+1%) must be within 500 m (or 5.25 km for User Location Protocol) of the actual position	ms	520.093	520.115	520.109	
Position data except for ELT (DT) (if applicable)	must be within 200 m of the actual horizontal position and 700 m of the altitude	P / F	P	P	P	
Position data for ELT(DT)		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	
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	113	114	113	Manufacturer specified value: 140
Actual duration of Self-test with encoded location	Less than maximum duration	s	76	71	72	
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		

Result: Pass



Parameters to be Measured	Range of Specification	Units	Test Results	Comments
9. Thermal Shock				
Model: RLB-44, S/N: TA000003, TUV Ref: TSR1 and Modification State 1				
Soak Temperature	30°C difference	°C	10	Result: Pass
Measurement Temperature		°C	-20	
Transmitted Frequency			Min	
Nominal value	C/S T.001	MHz	406.0310553	
Short-term stability	$\leq 2 \times 10^{-9}$	/100ms	56.765E-11	
Medium-term stability – Slope	$(-2 \text{ to } +2) \times 10^{-9}$	/min	-18.900E-12	
Medium-term stability – Residual frequency variation	$\leq 3 \times 10^{-9}$		71.576E-11	
Transmitter power output	35 - 39	dBm	36.11	
Digital message	correct	P/F	P	
			Max	
			406.0310770	
			10.392E-10	
			16.597E-10	
			16.220E-10	
			36.26	



Parameters to be Measured	Range of Specification	Units	Test Results	Comments
10. Operating Lifetime at Minimum Temperature				
Model: RLB-44, S/N: TA000022, TUV Ref: TSR15 and Modification State 2				
Pre-test battery discharge duration (operating) required				
		mAh	341.2	
Pre-test battery discharge duration (operating)		mAh	488.6*	
Duration	>48	Hours	71.5 Hours at T _{min} = -20°C	*The battery was discharged exceeded the requirements for Cospas Sarsat T.007. This was necessary to meet the requirements of RTCM 11000.5. 406 MHz self-terminated.
Effective Operating Lifetime duration	>48	Hours	71.5 Hours at T _{min} = -20°C	
Transmitted Frequency			Min Max	Min/Max results are up to the manufacturer declared lifetime of 48hrs. MTS results exclude the first 30 mins of data (included in the test results section of this report).
Nominal value	C/S T.001	MHz	406.0310718	RLS Protocol
Short-term stability	≤ 2x10 ⁻⁹	/100ms	8.255E-10	
Medium-term stability – Slope	(-1 to +1)x10 ⁻⁹	/min	-3.751E-10	
Medium-term stability – Residual frequency variation	≤ 3x10 ⁻⁹		5.258E-10	
Transmitter power output	35 - 39	dBm	35.95	
Digital message	correct	P/F	P	
Home transmitter continuous operation during the lifetime test		hours	75.06	
Home frequency			Start of Test	End of test taken as 48hrs (Manufacturer declared lifetime).
Home peak power level		MHz	121.4995	
Home transmitter duty cycle		dBm	16.4	
		%	98.13	
			End of Test	
			121.4995	
			16.7	
			98.15	