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Report On

Emergency Beacons Testing of the
ACR Electronics, Inc. RLB-41
In accordance with IEC 61097-2 Ed 3 2008

Document 75927040 Report 04 Issue 1 **November 2015**

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REPORT ON

Emergency Beacons Testing of the
ACR Electronics, Inc.
RLB-41

Document 75927040 Report 04 Issue 1

November 2015

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DATED

6 November 2015	6 November 2015	6 November 2015

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CONTENTS

SECTION 1

REPORT SUMMARY

Emergency Beacons Testing of the
ACR Electronics, Inc.
RLB-41

1.1 INTRODUCTION

The information contained in this report is intended to show verification of the Emergency Beacon Testing of the ACR Electronics, Inc. RLB-41 to the requirements of IEC 61097-2.

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	ACR Electronics, Inc.
Model Number(s)	RLB-41
Serial Number(s)	S/N: #6 (TUV Ref TSR0066) S/N: #7 (TUV Ref TSR0067) S/N: #8 (TUV Ref TSR0068) S/N: #9 (TUV Ref TSR0064) S/N: #15 (TUV Ref TSR0058) S/N: #26 (TUV Ref TSR0051) S/N: #20 (TUV Ref TSR0036)
Number of Samples Tested	7
Test Specification/Issue/Date	IEC 61097-2 Ed 3 2008
Date of Receipt of Test Samples	9 March 2015
Order Number Date	31575 6 June 2014
Start of Test	17 November 2014
Finish of Test	25 September 2015
Name of Engineer(s)	R Hampton M Hardy J Tuckwell S Mooney M Cox J Lunn I Bromley A Guy F Van Niekerk C Bowles

1.2 BRIEF SUMMARY OF RESULTS

The information contained in this report is intended to show verification of the Emergency Beacon Testing of the ACR Electronics, Inc. RLB-41 to the requirements of IEC 61097-2.

Section	IEC 61097-2 Spec. Clause	Test Description	Result	Comments
Configuration: RLB-41 (Conducted) S/N: #15 (TUV Ref TSR0058)				
2.1	A.1.1	Message Format and Homing Device Checks	Pass	-
2.2	A.1.2	Dry Heat	Satisfactory	-
2.3	A.1.3	Damp Heat	Satisfactory	-
2.4	A.1.4	Vibration	Satisfactory	-
2.5	A.1.5	Ruggedness	Satisfactory	-
	A.1.10	Spurious Emissions	Satisfactory	-
	A.1.11	Battery capacity and low-temperature test	Satisfactory	-
	A.1.12	(Limited) Cospas-Sarsat Type Approval Test Procedure	Satisfactory	-
Configuration: RLB-41 (Radiated) S/N: #9 (TUV Ref TSR0064)				
2.1	A.1.1	Message Format and Homing Device Checks	Pass	-
2.2	A.1.2	Dry Heat	Satisfactory	--
2.3	A.1.3	Damp Heat	Satisfactory	-
2.4	A.1.4	Vibration	Satisfactory	-
2.5	A.1.5	Ruggedness	Satisfactory	-
2.6	A.1.6	Drop on Hard Surface	-	See Section 2.6 Damage to antenna
2.7	A.1.7	Drop into Water (NUA)	Satisfactory	-
2.8	A.1.8	Thermal Shock	Satisfactory	-
2.9	A.1.9	Immersion	Satisfactory	
2.10	A.1.10	Spurious Emissions	Satisfactory	-
2.11	A.1.11	Battery Capacity and Low-Temperature Test	Satisfactory	-
2.12	A.1.12	(Limited) Cospas-Sarsat Type Approval Test Procedure	Satisfactory	-
2.13	A.1.13	Interference Test (Immunity to RF)	Satisfactory	-
2.14	A.1.13	Interference Test (Immunity to ESD)	Satisfactory	-
2.15	A.1.14	Conducted Interference	-	N/A

Section	IEC 61097-2 Spec. Clause	Test Description	Result	Comments
Other Tests (Non Compulsory Sequence of Tests) **Configuration: RLB-42 S/N #6, #7, #8, #9, #15, #20, #26 (TUV Ref TSR0066, 0067, 0068, 0064, 0058, 0036, 0051)**				
2.16	A.2.1	Test of Operational Requirements (NUA)	-	See Section 2.16
2.17	A.2.2	Automatic Release Mechanism and Automatic Activation test for Class 1 and Class 2 satellite EPIRBs	Satisfactory	-
2.18	A.2.3	Stability and Buoyancy	Satisfactory	-
2.19	A.2.4	Float Free Activation (Salt Water Activation)	Satisfactory	-
2.20	A.2.5	Safety	-	See Section 2.21
2.21	A.2.6	Compass Safe Distance	-	See Section 2.22
2.22	A.2.7	Solar Radiation	-	See Annex B
2.23	A.2.8	Oil Resistance	-	See Annex B
2.24	A.2.9	Corrosion	Satisfactory	-
2.25	A.2.10	Signal Light	-	See Opti Consulting Limited report OC-0522-01
2.26	A.2.11	GNSS Receiver	-	Refer to TÜV SÜD document 75928177 Report 05
2.27	A.2.12	121.5MHz Homing Device	Pass	-
2.28	5.5.1.1	Test to Prevent Release when Water Washes Over the Unit (Hose Stream)	Satisfactory	Carried out by TUV NEL.

1.3 APPLICATION FORM

Beacon Manufacturer and Beacon Model

Beacon Manufacturer	ACR Electronics, Inc.
Beacon Model Name	RLB-41
Additional Beacon Model Names	GlobalFix ™ V4

Beacon Type and Operational Configurations

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

Beacon Characteristics

Characteristic	Specification
Operating frequency	406.040 MHz 121.5 MHz
Operating temperature range	Tmin = -20 °C Tmax= 55°C
Temperature, at which minimum duration of continuous operation is expected	-20 °C
Operating lifetime	48 hours for 121.5 MHZ and 406 MHz
Beacon power supply type (internal non-rechargeable, internal re-chargeable, external, combined, other)	Internal
External power supply parameters (AC/DC and nominal voltage)	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	LiMnO2
Battery cell model name, cell size, number of cells in a battery pack, and details of the battery pack electrical configuration	CR-123A, 2/3A size, 3 battery packs, 3 cells each
Battery cell manufacturer	Panasonic
Battery pack manufacturer and part number	ACR pack P/N: A3-06-2865 ACR cell P/N: A1-13-0118 Panasonic cell P/N: CR-123A
Beacon manufacturers declared maximum allowed cell shelf-life (from date of cell manufacture to date of battery pack installation in the beacon)	0.25 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 Ltd, (Made in New Zealand)
Oscillator model name/ part number	RAKON P/N 5344LF, ACR P/N A1-11-0940
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	ACR Electronics, Inc.
Antenna part name and part number	Antenna Assy RLB's, P/N A3-06-2554
Antenna cable assembly min/max RF- losses at 406 MHz, if applicable	N/A
Navigation device type (Internal, External or None)	Internal
Features in beacon that prevent degradation to 406 MHz signal or beacon lifetime	Yes

Characteristic	Specification
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)	20 min to 4 hours
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	GlobalTop Tech Inc.
– Navigation device model name and part Number	ACR P/N: A1-11-0877-1 GlobalTop P/N: gms-hpr
– Internal navigation device antenna type(integrated, internal, external, passive/active) , manufacturer and model	Integrated in A1-11-0877-1
– GNSS system supported (e.g. GPS, GLONASS, Galileo)	GPS
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.)	Refer to Operating Manual	Refer to Operating Manual
– The content of the encoded position data fields of the self-test message has default values	Yes	Yes if NO GNSS found. No if GNSS found
– 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 121.5 MHz	No
– Self-test can be activated directly at beacon (Yes or No)	Yes	Yes
– List of Items checked by self-test	See Note 1	See Note 1
– Self-test/ GNSS self-test 406 MHz burst duration (440 or 520 ms)	440 ms	520 ms
– Self-test message length format flag in bit 25, ("0" or "1")	1	1
– Maximum duration of a self-test mode, sec	11 Seconds	132 Seconds
– Maximum recommended number of self-tests during battery pack replacement period	120	84
– 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	No
– Automatic termination of self-test mode immediately after completion of the self-test cycle (Yes or No)	Yes	Yes
– Maximum number of GNSS Self Tests (beacons with internal navigation devices only)	N/A	84

Self-Test Mode Characteristics:	Self-Test Mode	Optional GNSS Self-test Mode
– GNSS Self-test results in transmission of a single burst, irrespectively of the test result (Yes or No)	N/A	Yes
– Maximum number of self-tests during battery pack replacement period	120	84
– Self-test/ GNSS self-test can be activated from beacon remote activation points (Yes & details or No)	N/A	N/A
– List all methods of Self-test mode and GNSS Self-test modes activation. Provide details on a separate sheet to describe	Switch at EPIRB Activated less than 2 s	Switch at EPIRB Activated more than 5 s

NOTE 1:

First pass/fail indication:

- Beacon will check Battery Capacity monitor.
- Beacon will check for previous emergency activations.

Second pass/fail indication:

- Beacon will test that the PLL locks.
- Beacon will test that 406 MHz RF power is present during a 406 MHz transmission.
- Beacon will test battery voltage during a 406 MHz transmission.
- Beacon will test that 121.5 MHz RF power is present during a 121.5 MHz transmission.

Third pass/fail indication:

- Beacon will check the code checksum.
- Beacon will check the serialization of the current (ACR or POS) 406 message checksum.
- Beacon will check for GPS module communication.

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

RLS Location Protocol (tick where appropriate) [1]		EPIRB
		ELT
		PLB
User Location Protocol (tick where appropriate)	X	Maritime with MMSI
	X	Maritime with Radio Call Sign
	X	EPIRB Float Free with Serial Number
	X	EPIRB Non Float Free with Serial Number
	X	Radio Call Sign
		Aviation
		ELT with Serial Number
		ELT with Aircraft Operator and Serial Number
		ELT with Aircraft 24-bit Address
		PLB with Serial Number
Beacon includes a homer transmitter(s) (Yes or No) - homer transmitter(s) frequency - homer transmitter(s) power		Yes 121.5 MHz 17 - 22 dBm EIRP
□ homer transmitter(s) duty cycle □ duty cycle of homer swept tone		96 % 33 %
Beacon includes a high intensity flashing light (e.g. Strobe)		Yes
- light intensity		>0.75 cd
- flash rate		20 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.		N/A
Beacon includes automatic activation mechanism (Yes or No). Specify type of automatic beacon activation mechanism		Yes. Automatic activation occurs when water makes contact across water sensors when not in bracket
Beacon includes features and functions not listed above, related or non-related to 406 MHz (Yes or No) List features and use a separate sheet if insufficient space		No

1 RLS protocols will be effective as of 1 November 2015. The use of RLS-enabled beacons will be regulated by national administrations.

Beacon model hardware part number (P/N) and version	A3-06-2862, Rev B
Beacon model software/firmware P/N, version, date of issue/releases	K3-01-0122, Version B, Release 10/15/2014
Beacon model printed circuit board P/N and version	A3-07-0413 Rev G
Known non-compliances with C/S T,001 requirements(Yes or No) If Yes, provide details (or use a separate sheet if insufficient space)	No
Beacon Manufacturer Point of Contact (POC) for this Type Approval application:	Name and Job Title: Mr. Dan Stankovic, Director of Certification and Test. Phone: 954-981-3333 X 2175 E-mail: dan.stankovic@acrartex.com

Dated:.07/10/2015..... Signed: Dan Stankovic, Director of Certification and Test

1.4 PRODUCT INFORMATION

1.4.1 Technical Description

The Equipment Under Test (EUT) was an ACR Electronics, Inc. RLB-41 as shown in the photograph below. A full technical description can be found in the manufacturer's documentation.

Equipment Under Test

1.4.2 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. This EUT, S/N: #15 (TUV Ref TSR0058) was used for tests where the specification required a Functional Check and a Functional Test.

EUT, S/N: #9 (TUV Ref TSR0064) was a fully packaged beacon, similar to the proposed production beacons equipped with its proper antenna. This EUT was used for all tests required within the specification but was only subjected to a Functional Check, where required.

EUT, S/N: #26 (TUV Ref TSR0051) was a fully packaged beacon, similar to the proposed production beacons equipped with its proper antenna. This EUT was used for the Compass Safe Distance test.

EUT, S/N: #20 (TUV Ref TSR0036) was a fully packaged beacon, similar to the proposed production beacons equipped with its proper antenna. This EUT was used for the Corrosion test.

EUT, S/N: #7 (TUV Ref TSR0067) was a fully packaged beacon, similar to the proposed production beacons equipped with its proper antenna. This EUT was used for the Stability and Buoyancy test.

EUT, S/N: #8 (TUV Ref TSR0068) was a fully packaged beacon, similar to the proposed production beacons equipped with its proper antenna. This EUT was used for the Automatic Release and Activation test.

1.4.3 Monitoring of Performance for EMC tests

EUT Monitoring in Standby Mode

The EUT was monitored throughout the test with a Beacon tester. The Beacon tester was set to record any unintentional transmissions from the EUT.

A spectrum analyser was also used to monitor any unintentional 121.325 MHz signal transmissions.

Throughout the test the EUT's LEDs rate was also observed using CCTV (radiated immunity) and directly (ESD) for any unintentional activation

EUT Monitoring in Active Mode

The EUT was provided with positional data from a GPS simulator and the 406.040 MHz messages were monitored by Beacon tester. The 121.325 MHz homing signal was monitored with a spectrum analyser.

Throughout the test the LED flash rate was also observed using CCTV (radiated immunity) and directly (ESD). The magnitude of the 406.040 MHz signal was recorded on a signal analyser prior to the start of the test and then compared to the view trace for each burst.

At the end of the test the Beacon tester files were analysed for positional data accuracy and message consistency.

1.4.4 Performance Criteria for EMC tests (Acceptable Performance Limits)

In Active mode the EUT should continue to work correctly; the beacon should continue to transmit the 406.040 MHz and 121.325 MHz signals with no degradation of amplitude.

In Standby mode there should be no transmissions.

1.4.5 Test Conditions for EMC tests

For all EMC tests the EUT was set up in accordance with the relevant test standard and to represent typical operating conditions. Tests were applied with the EUT situated in a shielded enclosure, test laboratory or an open test area as appropriate.

The EUT was powered from the internal battery.

Test Results

IEC 60945, Clause 5.3 states:

The measured test results shall be compared with the corresponding acceptable performance limits and the EUT shall pass the test only if the measured performance margin is favourable and greater than the measurement uncertainty. The test report shall show, for each test measurement, the test result, its associated measurement uncertainty, the acceptable performance limits, and the acceptable performance margin, as applicable.

The tests detailed in this report met the above test requirements.

1.4.6 Modes of Operation

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

Off/Standby Mode
- Main activation button to “OFF” position

Self-test
- Depress Self-test activation button for 2 seconds
- List of items checked as per Customer Supplied Information (Application Form)

Long/GPS/GNSS Self-test
- Depress Self-test activation button for 6 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
- Depress Main activation button
- 121 Homer active and offset
- GPS operating in normal duty cycle for the following navigation input conditions [Note1]
- No navigation data applied

Note 1: The manufacturer has declared that the GPS receiver operates as follows:

GPS On/Off Cycle:
The following schedule is followed until an initial valid GPS location is encoded into the beacon message:
- For the first 60 minutes, the GPS is turned on for 10 minutes once every 20 minutes.
- For the next 60 minutes, the GPS is turned on for 5 minutes once every 15 minutes.

If a valid location fix is obtained during either of the above GPS on times, the GPS is turned off immediately. The GPS is then turned on no less than 25 minutes and no more than 30 minutes from the time the GPS was previously turned on, then the GPS is then turned on and off according to the schedule below. If no valid fix was obtained during the above schedule, the schedule below is followed.

- For the next 6 hours the GPS is turned on once every 30 minutes and is on for a period of 5 minutes or until a valid location fix is obtained.
- For the next 18 hours the GPS is turned on once every 2 hours and is on for a period of 5 minutes or until a valid location fix is obtained.
- Until the battery end-of-life, the GPS is turned on once every 4 hours and is on for a period of 5 minutes or until a valid location fix is obtained.

1.5 DEVIATIONS

Limited COSPAS SARSAT testing occurred during the compulusory sequence of tests. This was agreed with the Notified Body to allow the COSPAS SARSAT type approval to take place in parallel. The limited testing was carried out so that continuing compliance could be demonstrated.

The Corrosion test was carried out on an additional sample and therefore not included in the compulsory sequence of tests.

The compulsory sequence of tests was, where possible, carried out on both the conducted and radiated sample, however, for tests requiring physical impact and / or water the EUT was not considered suitable due to the addition of the 50Ω connector conducted ports.

The spurious emissions test was carried out in accordance with IEC 61097-2. Further spurious emissions plots can be seen in the limited COSPAS SARSAT test results in Annex A.

1.6 WAIVER REQUESTS

Waiver requests have been provided for Solar Radiation and Oil Resistance.

1.7 MODIFICATIONS

No modifications were made to the samples under test during the test programme.

1.8 REPORT MODIFICATION RECORD

Issue 1 – First Issue

Product Service

SECTION 2

TEST DETAILS

Emergency Beacons Testing of the
ACR Electronics, Inc.
RLB-41

2.1 MESSAGE FORMAT AND HOMING DEVICE CHECKS

2.1.1 Specification Reference

IEC 61097-2, clause A.1.1

2.1.2 Equipment Under Test and Modification State

RLB-41 S/N: #15 (TUV Ref TSR0058) - Modification State 0
RLB-41 S/N: #9 (TUV Ref TSR0064) - Modification State 0

2.1.3 Date of Test

30 March 2015

2.1.4 Test Equipment Used

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

2.1.5 Environmental Conditions

Ambient Temperature 22.4.0°C
Relative Humidity 48.1.0%

2.1.6 Test Results

Visual Inspection

Prior to the start of the testing schedule the EUT was visually inspected. No signs of damage were found.

Performance Check

A Performance Check was conducted to ensure that the EUT was functional before all upcoming tests.

Summary of Performance Check Results

RLB-41 S/N: #15 (TUV Ref TSR0058)

Parameter	Result
Self-test Mode:	
Self-test Message	FFFED08C9EF9C0637FDFF83D15B7
Normal Mode:	
Normal Message	FFFE2F8C9EF9C0637FDFF83D15B783E0F66C
406 MHz Frequency	406.0400
121 MHz Presence	P

Summary of Performance Check Results

RLB-41 S/N: #9 (TUV Ref TSR0064)

Parameter	Result
Self-test Mode:	
Self-test Message	FFFED08C9EF9C0637FDFF83D15B7
Normal Mode:	
Normal Message	FFFE2F8C9EF9C0637FDFF83D15B783E0F66C
406 MHz Frequency	406.0400
121 MHz Presence	P

2.2 DRY HEAT

2.2.1 Specification Reference

IEC 61097-2, clause A.1.2

2.2.2 Equipment Under Test and Modification State

RLB-41 S/N: #15 (TUV Ref TSR0058) - Modification State 0
RLB-41 S/N: #9 (TUV Ref TSR0064) - Modification State 0

2.2.1 Date of Test

30 March 2015, 31 March 2015 and 07 April 2015 and 08 April 2015

2.2.2 Test Equipment Used

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

2.2.3 Environmental Conditions

Ambient Temperature: 20.5 - 23.2 °C
Relative Humidity: 23.4 - 31.3 %

2.2.4 Test Setup

2.2.5 Test Method

Storage Test

The EUT's were placed in a climatic chamber where the temperature was increased from laboratory ambient temperature to +70°C. After approximately 12 hours, the temperature was returned to ambient conditions. The EUTs were subjected to a performance check at the end of the test.

Functional Test

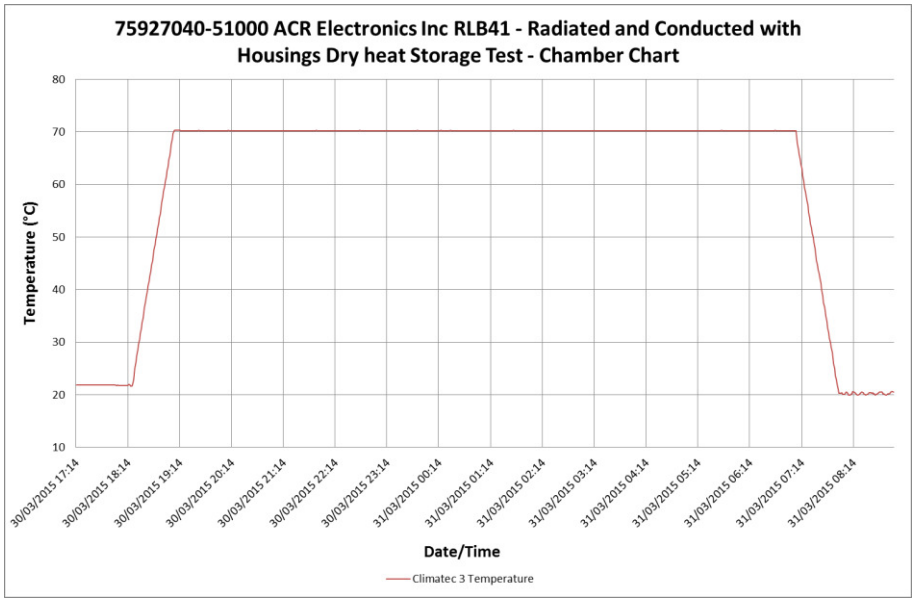
The EUTs were switched on, and placed in a climatic chamber where the temperature was increased from ambient temperature to +55°C. The conditions remained for a period of approximately 17 hours. Towards the end of this period the EUTs were subjected to a performance check and performance test. At the end of the test, the temperature was returned to laboratory ambient conditions.

At the conclusion of all testing, a satisfactory Performance Check was carried on both EUTs.

2.2.6 Test Results

Storage Test

Temperature Plot



Post-Storage Period Performance Check

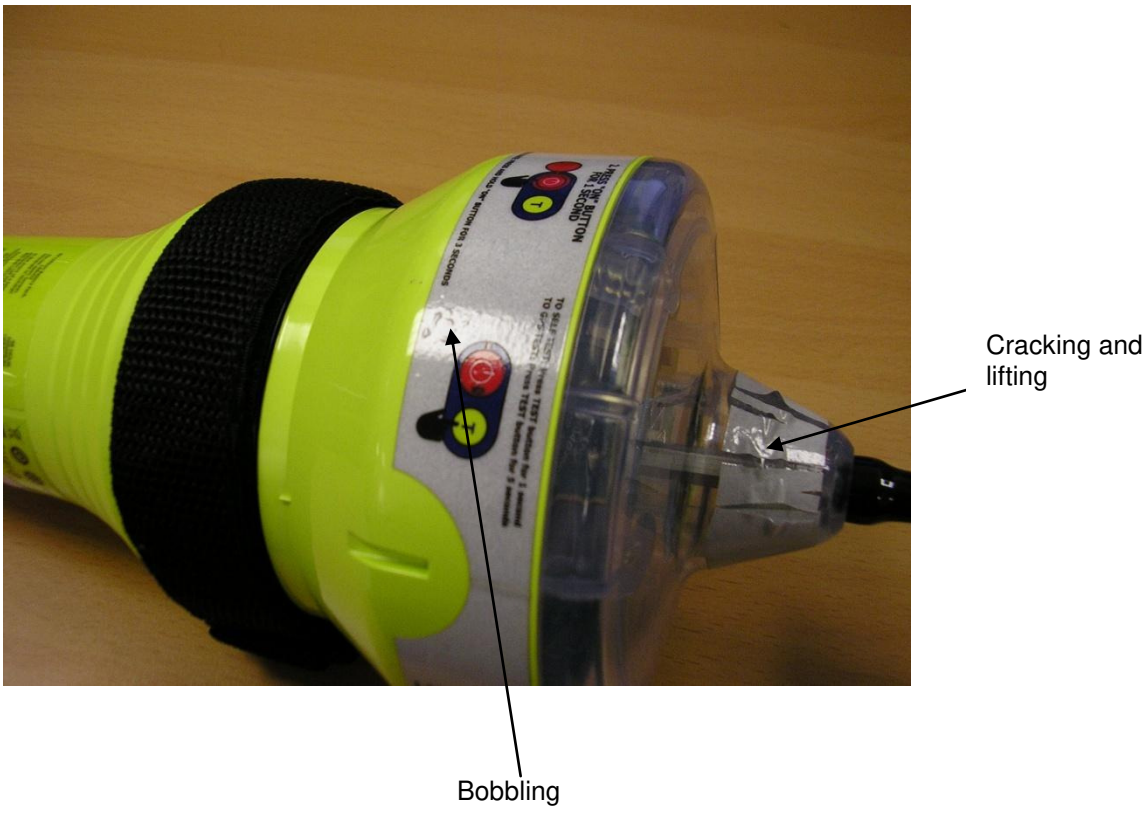
RLB-41 S/N: #15 (TUV Ref TSR0058)

Parameter	Result
Self-test Mode:	
Self-test Message	FFFED08C9EF9C0637FDFF83D15B7
Normal Mode:	
Normal Message 406 MHz Frequency 121 MHz Presence	FFFE2F8C9EF9C0637FDFF83D15B783E0F66C 406.039988 P

RLB-41 S/N: #9 (TUV Ref TSR0064)

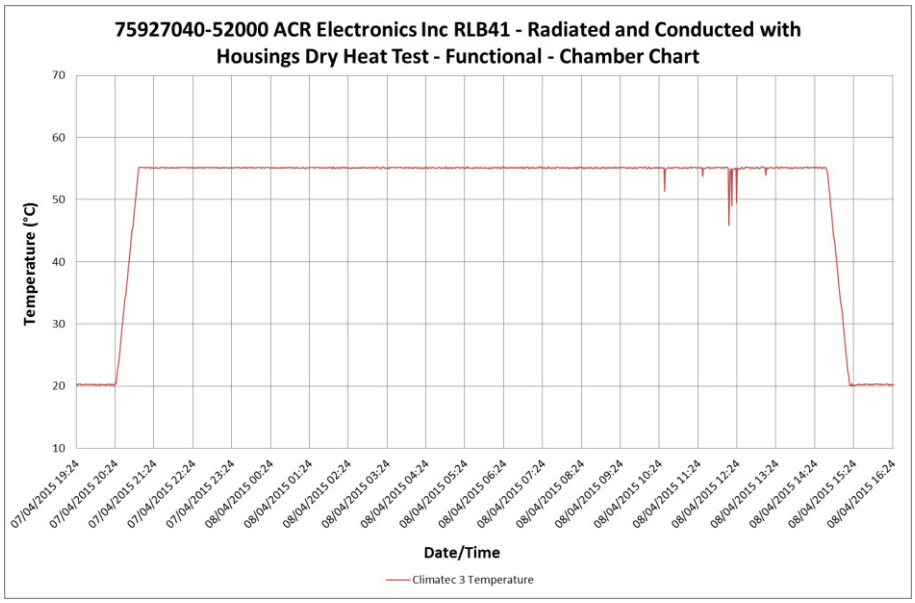
Parameter	Result
Self-test Mode:	
Self-test Message	FFFED08C9EF9C0637FDFF83D15B7
Normal Mode:	
Normal Message 406 MHz Frequency 121 MHz Presence	FFFE2F8C9EF9C0637FDFF83D15B783E0F66C 406.039983 P

Observation: it was noted after the 12 hour storage period there was some damage to the labels including cracking, lifting and bobbling as indicated below:



Functional Test

Temperature Plot

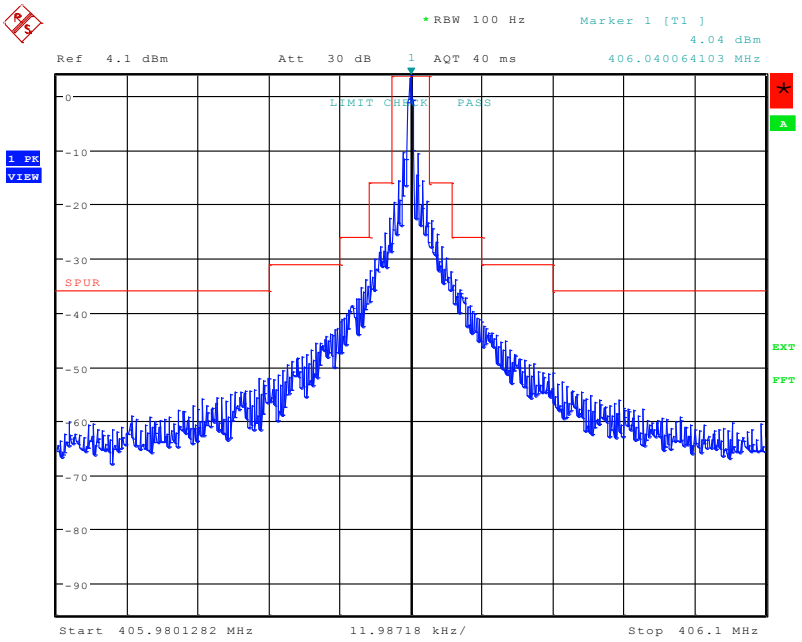


During Functional Period Performance Test

RLB-41 S/N: #15 (TUV Ref TSR0058)

Parameter	Result (Max / Min)
Output Power	37.67 / 37.66
Digital Message	FFFE2F8C9EF9C0637FDFF83D15B783E0F66C
Bit Rate	399.93 / 399.91
Modulation: Rise Time (us)	190.3 / 166.3
Modulation: Fall Time (us)	191.7 / 163.6
Positive Deviation (rad)	1.1848 / 1.0136
Negative Deviation (rad)	-1.1860 / -1.0253
Nominal Frequency (MHz)	406.0399700 / 406.0399699
Short-term Stability (/100 ms)	12.465E-11 / 10.024E-11
Medium-term Stability – Slope (/minute)	25.992E-12 / 53.624E-13
Medium-term Stability – Residual	10.359E-11 / 81.644E-12
Spurious Emissions	See plot below

Spurious Emissions



Date: 8.APR.2015 11:31:08

Post-Functional Period Performance Check

Parameter	Result
Self-test Mode:	
Self-test Message	FFFED08C9EF9C0637FDFF83D15B7
Normal Mode:	
Normal Message	FFFE2F8C9EF9C0637FDFF83D15B783E0F66C
406 MHz Frequency	406.0401
121 MHz Presence	P

Post-test Performance Check

Parameter	Result
Self-test Mode:	
Self-test Message	FFFED08C9EF9C0637FDFF83D15B7
Normal Mode:	
Normal Message	FFFE2F8C9EF9C0637FDFF83D15B783E0F66C
406 MHz Frequency	406.039974
121 MHz Presence	P

RLB-41 S/N: #9 (TUV Ref TSR0064)

Post-Functional Period Performance Check

Parameter	Result
Self-test Mode:	
Self-test Message	FFFED08C9EF9C0637FDFF83D15B7
Normal Mode:	
Normal Message 406 MHz Frequency 121 MHz Presence	FFFE2F8C9EF9C0637FDFF83D15B783E0F66C 406.0400 P

Post-test Performance Check

Parameter	Result
Self-test Mode:	
Self-test Message	FFFED08C9EF9C0637FDFF83D15B7
Normal Mode:	
Normal Message 406 MHz Frequency 121 MHz Presence	FFFE2F8C9EF9C0637FDFF83D15B783E0F66C 406.039981 P

2.3 DAMP HEAT

2.3.1 Specification Reference

IEC 61097-2, clause A.1.3

2.3.2 Equipment Under Test and Modification State

RLB-41 S/N: #15 (TUV Ref TSR0058) - Modification State 0
RLB-41 S/N: #9 (TUV Ref TSR0064) - Modification State 0

2.3.3 Date of Test

08 April 2015 and 09 April 2015

2.3.4 Test Equipment Used

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

2.3.5 Environmental Conditions

Ambient Temperature: 18.1 - 24.4 °C
Relative Humidity: 25.2 - 38.8 %

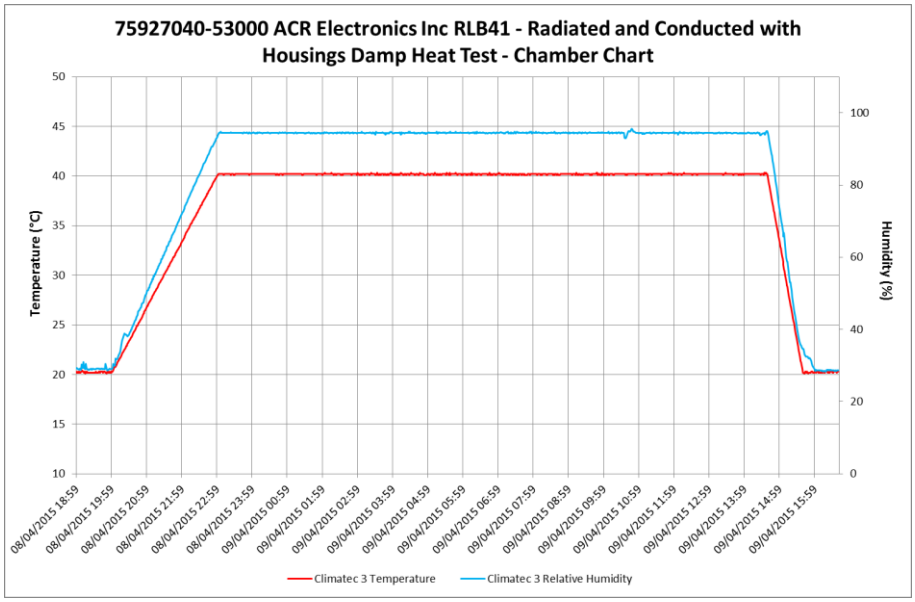
2.3.6 Test Setup

2.3.7 Test Method

The EUT was placed in a climatic chamber with the temperature increased to 40 °C and the relative humidity increased to 93 %. After 12 hours, the EUT was activated for at least 2 hours, during this period was subjected to a performance check.

2.3.8 Test Results

Temperature Plot



RLB-41 S/N: #15 (TUV Ref TSR0058)

Operational Period Performance Check

Parameter	Result
Self-test Mode:	
Self-test Message	FFFED08C9EF9C0637FDFF83D15B7
Normal Mode:	
Normal Message 406 MHz Frequency 121 MHz Presence	FFFE2F8C9EF9C0637FDFF83D15B783E0F66C 406.039962 P

Post-test Performance Check

Parameter	Result
Self-test Mode:	
Self-test Message	FFFED08C9EF9C0637FDFF83D15B7
Normal Mode:	
Normal Message	FFFE2F8C9EF9C0637FDFF83D15B783E0F66C
406 MHz Frequency	406.039968
121 MHz Presence	P

RLB-41 S/N: #9 (TUV Ref TSR0064)

Operational Period Performance Check

Parameter	Result
Self-test Mode:	
Self-test Message	FFFED08C9EF9C0637FDFF83D15B7
Normal Mode:	
Normal Message	FFFE2F8C9EF9C0637FDFF83D15B783E0F66C
406 MHz Frequency	406.039964
121 MHz Presence	P

Post-test Performance Check

Parameter	Result
Self-test Mode:	
Self-test Message	FFFED08C9EF9C0637FDFF83D15B7
Normal Mode:	
Normal Message	FFFE2F8C9EF9C0637FDFF83D15B783E0F66C
406 MHz Frequency	406.039982
121 MHz Presence	P

2.4 VIBRATION

2.4.1 Specification Reference

IEC 61097-2, clause A.1.4 incorporating the requirements of RTCM 11000.3 Clause A.6

2.4.2 Equipment Under Test and Modification State

RLB-41 S/N: #15 (TUV Ref TSR0058) - Modification State 0
RLB-41 S/N: #9 (TUV Ref TSR0064) - Modification State 0

2.4.3 Date of Test 00

21 April 2015, 29 April 2015 and 23 September 2015

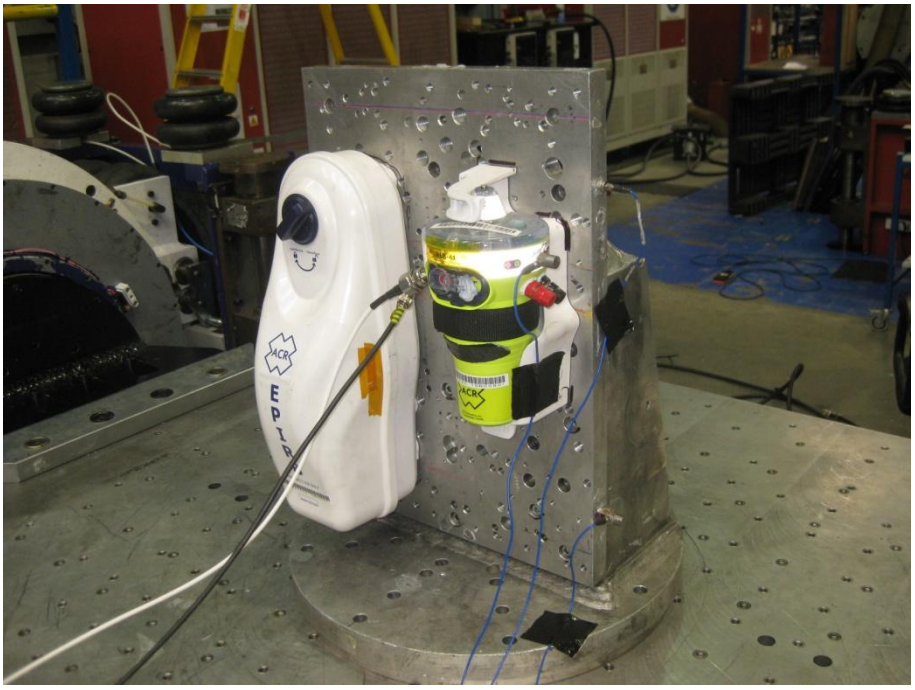
2.4.4 Test Equipment Used

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

2.4.5 Environmental Conditions

Ambient Temperature 18.4 - 19.0°C
Relative Humidity 45.9 – 57.9%

2.4.6 Test Setup



2.4.7 Test Method

The EUT's were fixed to the vibration table and was subject to the following vibration profiles:

Resonance Sweep

– 5 Hz and up to 13.2 Hz with an excursion of ±1 mm (7 m/s² maximum acceleration at 13.2 Hz);
– above 13.2 Hz and up to 100 Hz with a constant maximum acceleration of 7 m/s².

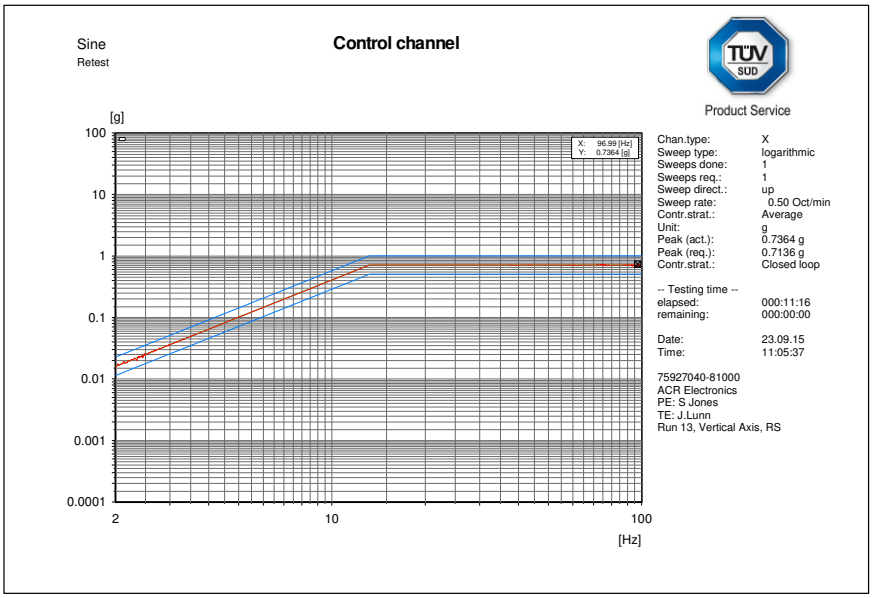
One sweep was performed at a rate of 0.5 octaves / minute.

The following resonant frequencies were found

Up and Down EUT in float free housing: 78.59 Hz
Side to Side EUT in float free housing: 81.97 Hz
Front and Back EUT in float free housing: 81.03 Hz
Up and Down EUT in manual release bracket: 48.37 Hz
Side to Side EUT in manual release bracket: 26.0 Hz
Front and Back EUT in manual release bracket: 39.33 Hz

Where a resonance frequency was found the EUT was subject to the 2 hour endurance run at that frequency. If not frequency was found the EUT endurance run was carried out at 30 Hz. At the end of the test, each EUT was subjected to a Performance Check.

Up and Down (Float Free Housing) Res Search – Control and EUT



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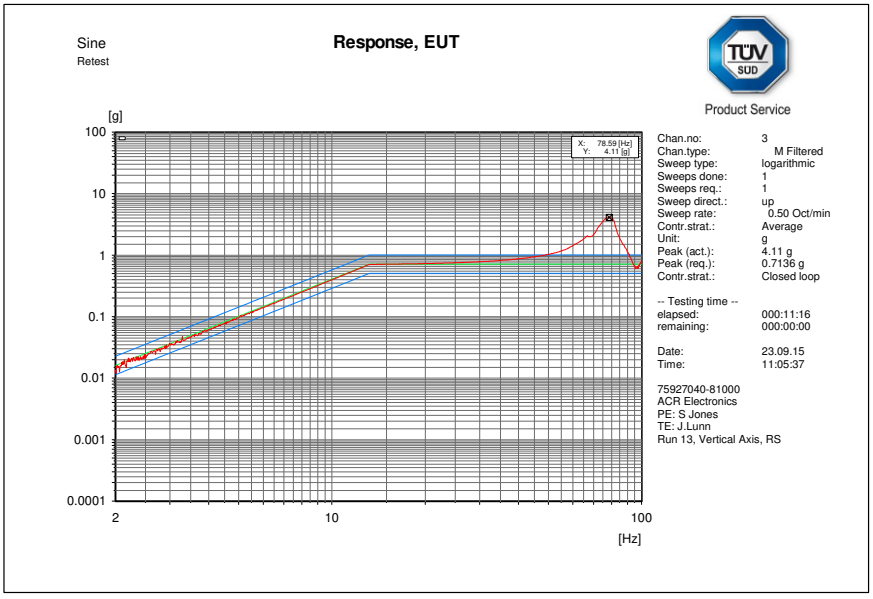

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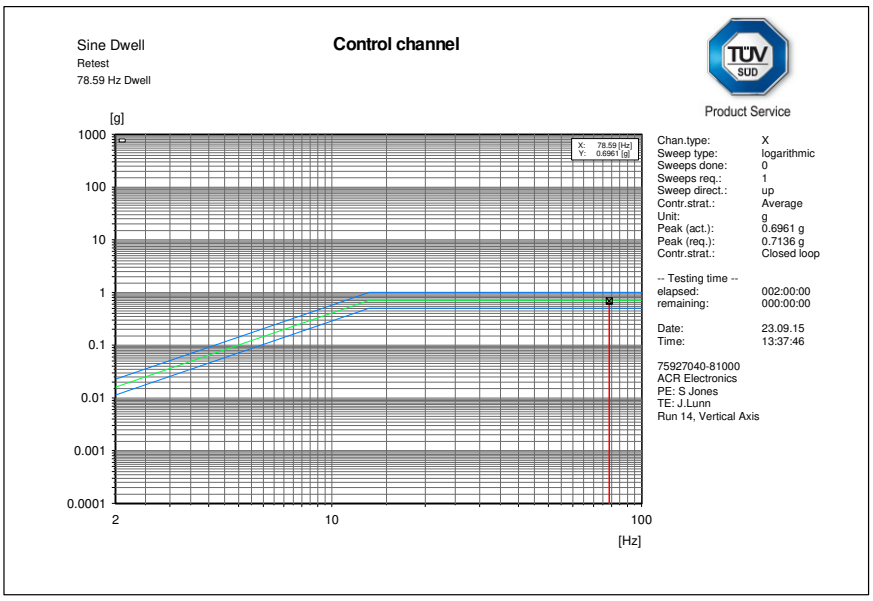
Up and Down (Float Free Housing) Endurance Run (78.59 Hz) – Control and EUT



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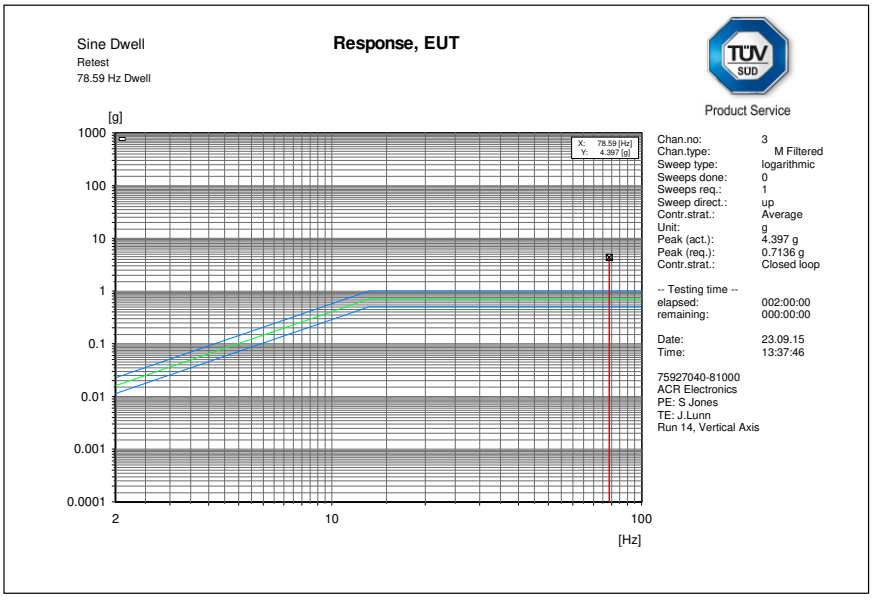

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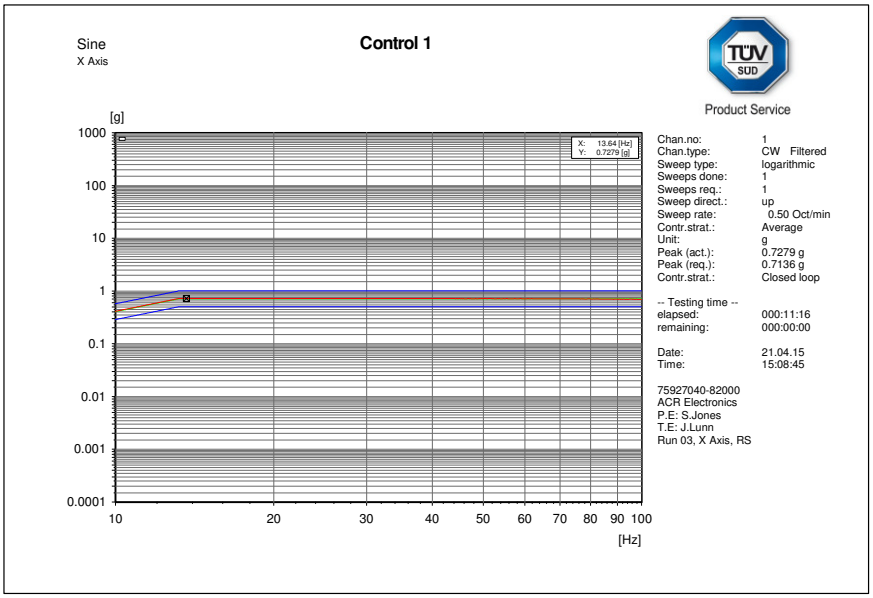
Side to Side (Float Free Housing) Res Search – Control and EUT



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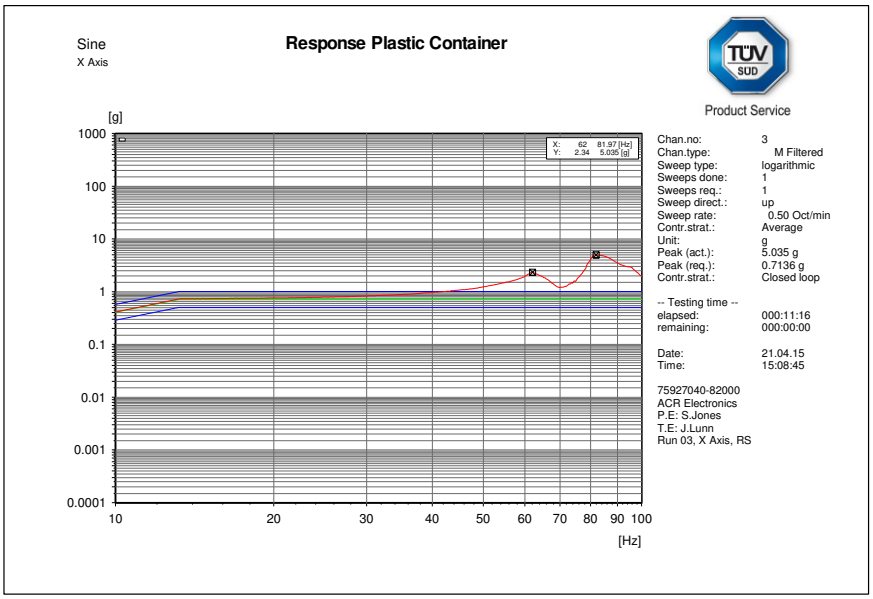

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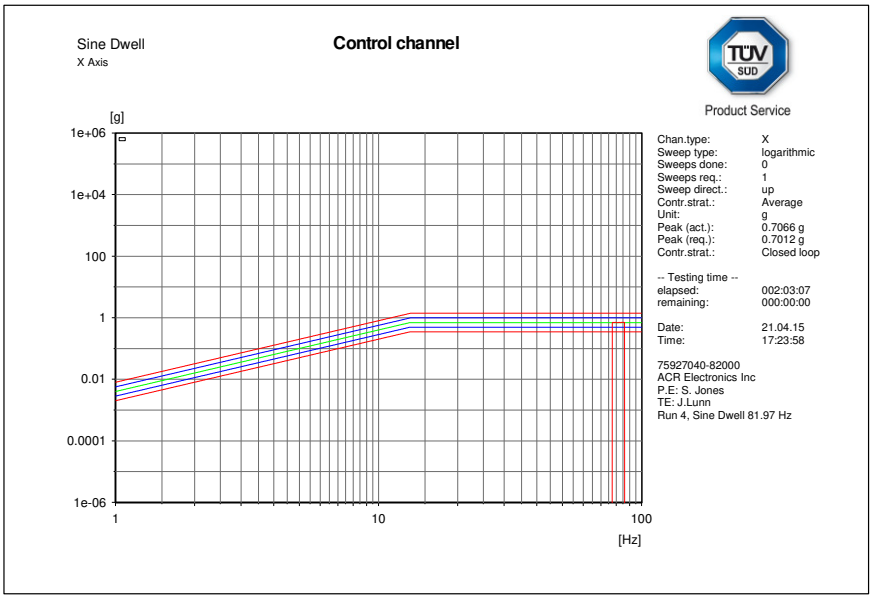
Side to Side (Float Free Housing) Endurance Run (81.97 Hz) – Control and EUT



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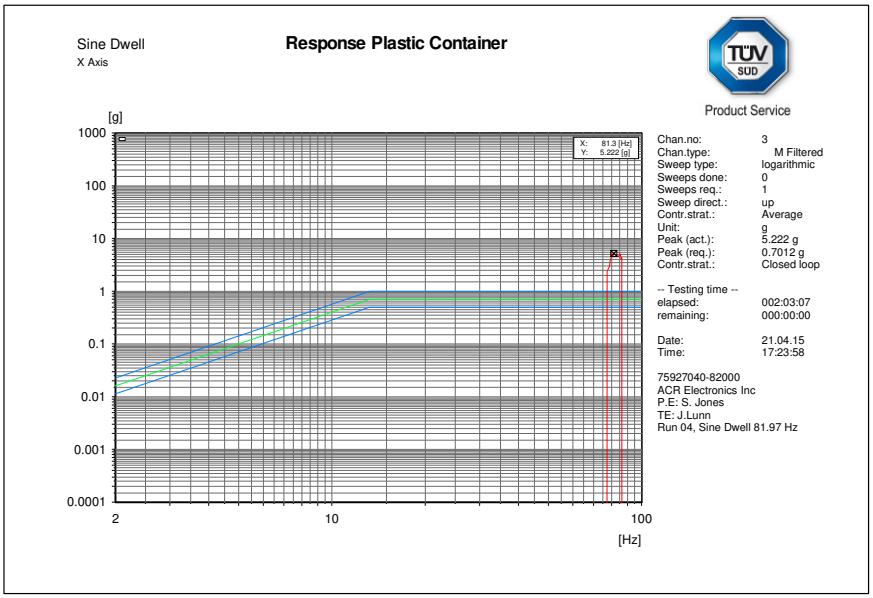

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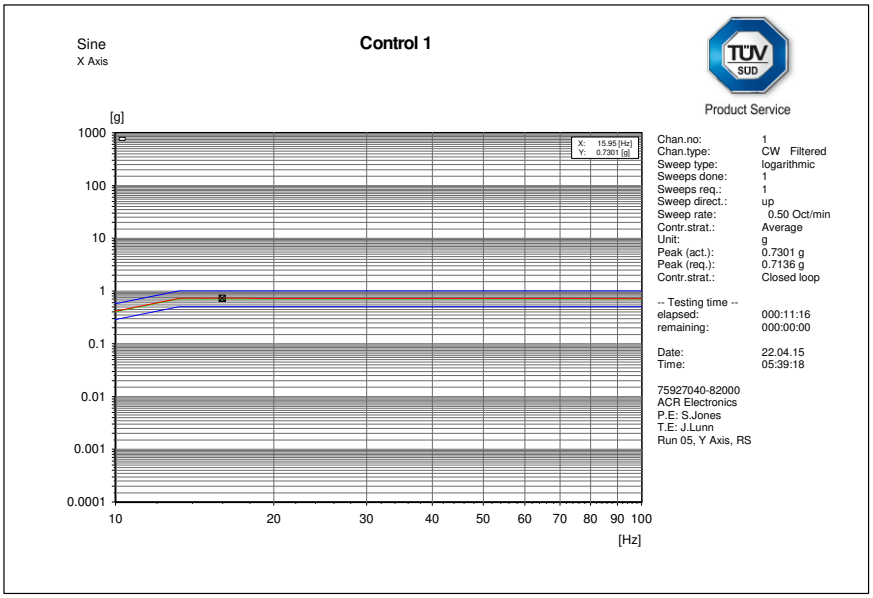
Front and Back (Float Free Housing) Res Search – Control and EUT



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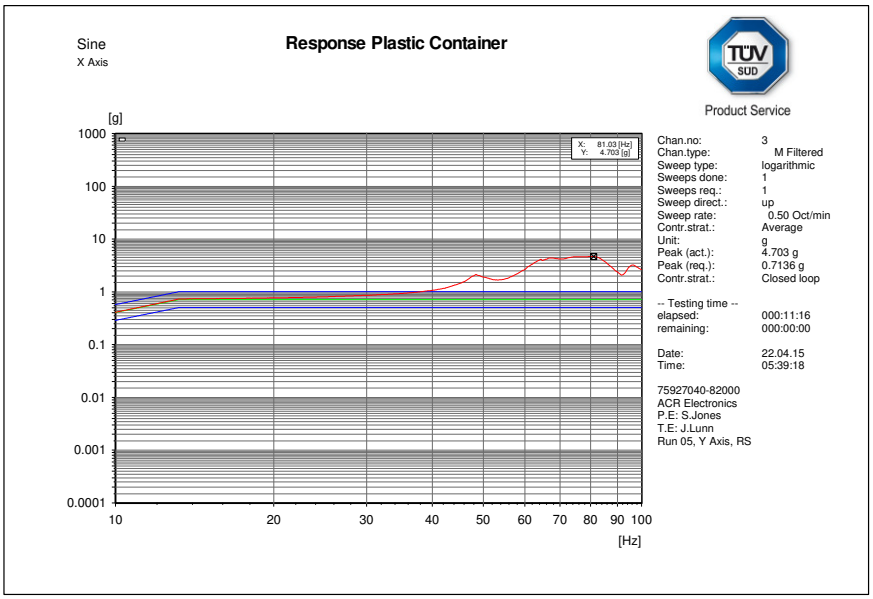

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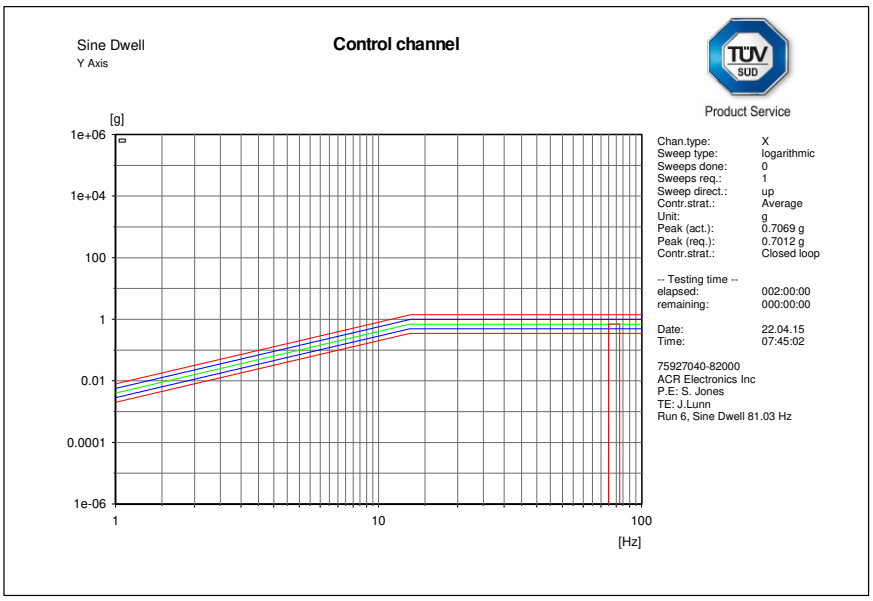
Front and Back (Float Free Housing) Endurance Run (81.03 Hz) – Control and EUT



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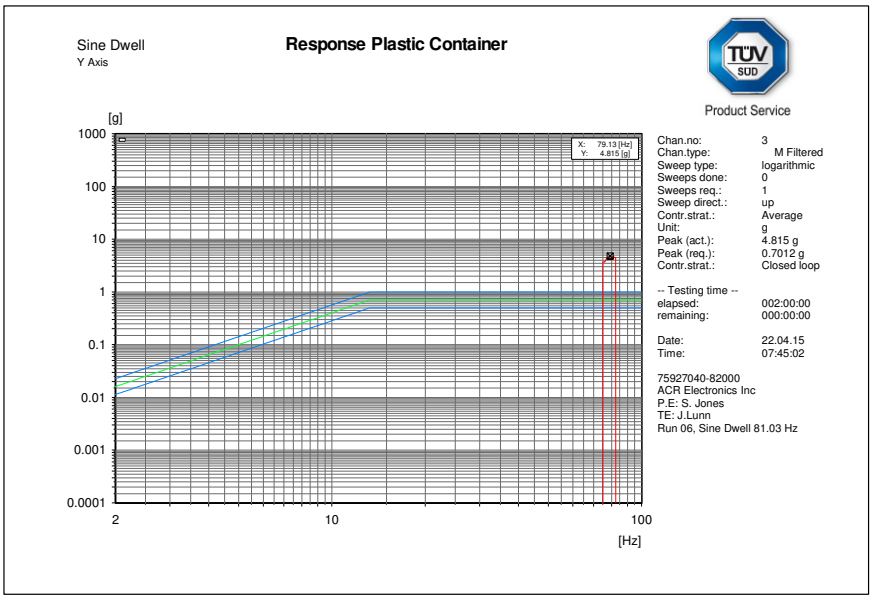

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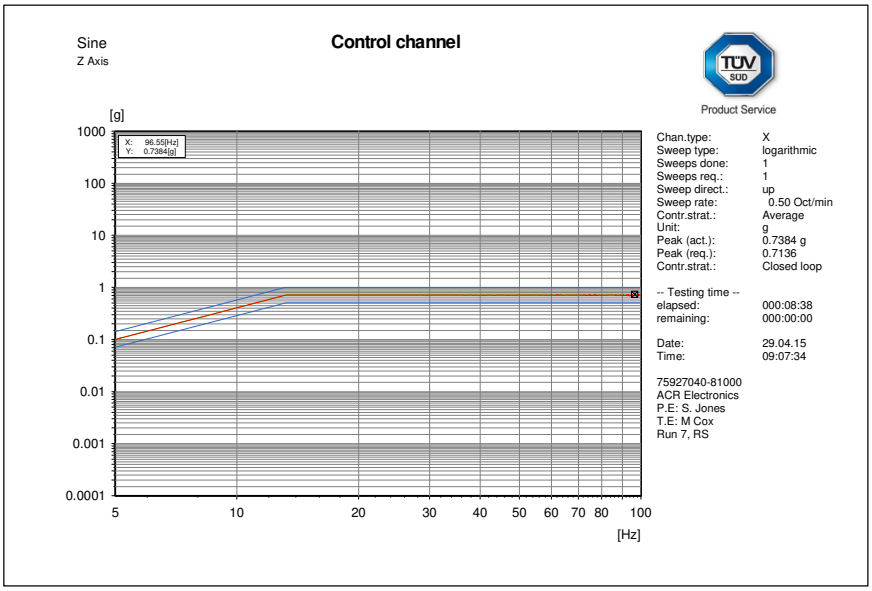
Up and Down (Manual Bracket) Res Search – Control and EUT



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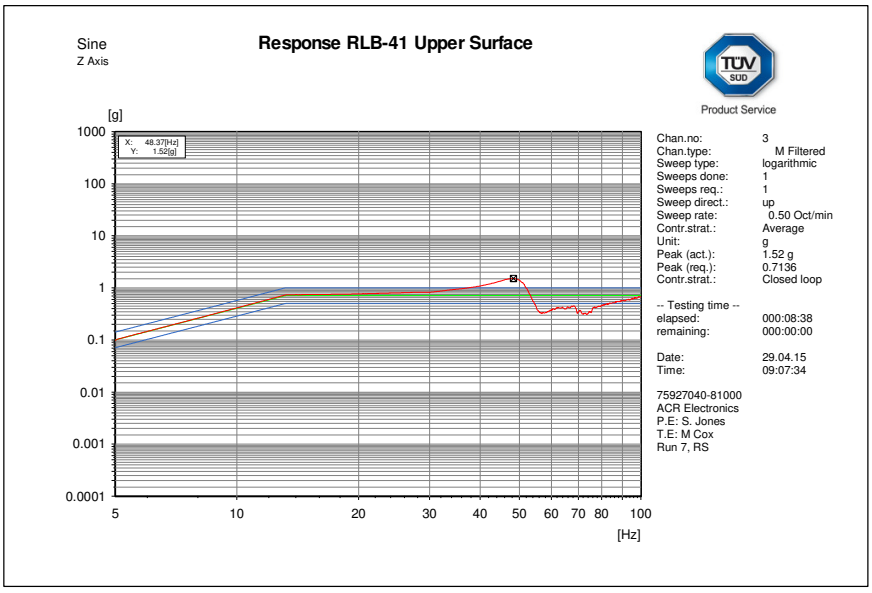

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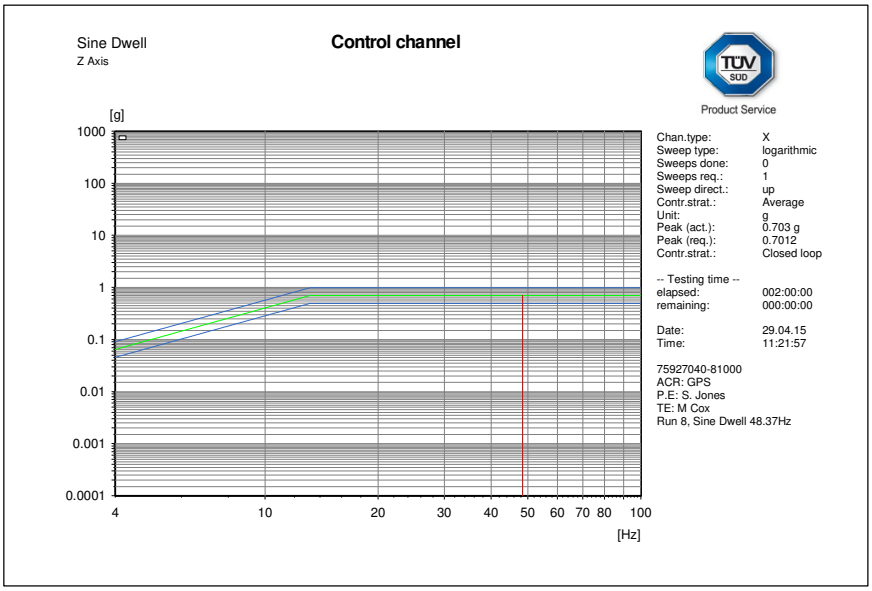
Up and Down (Manual Bracket) Endurance Run (48.37 Hz) – Control and EUT



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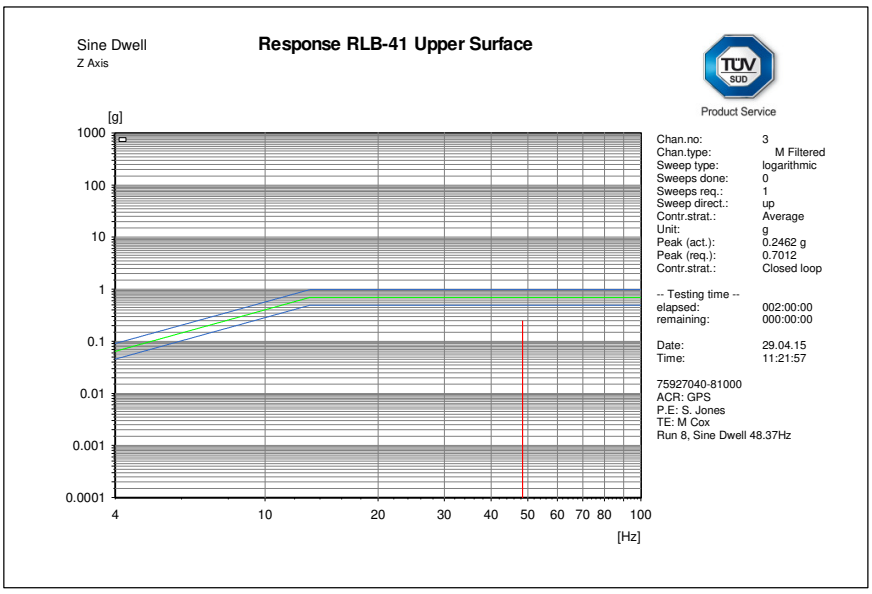
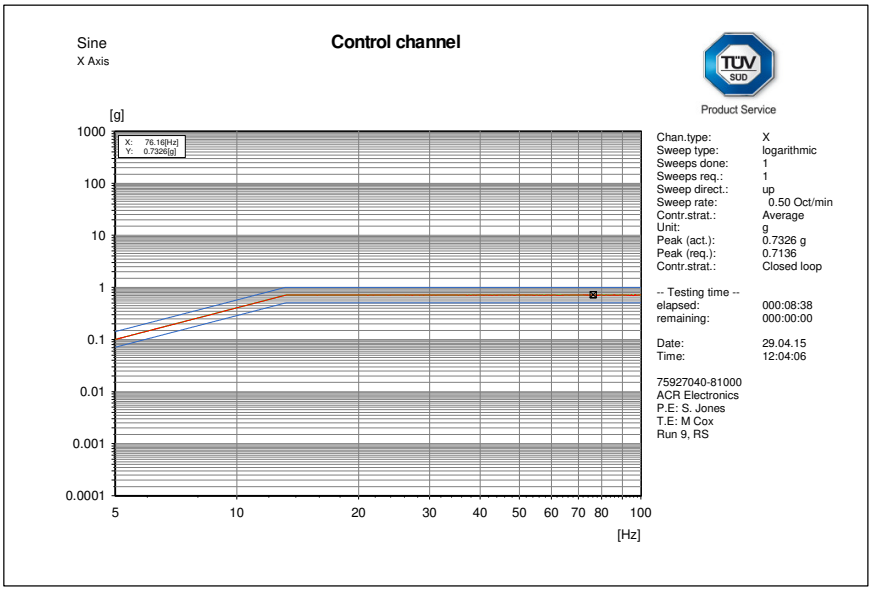


C:\VcpNT\Daten\m+p\ACR\75927040-81000\48.37Hz_001.rsd

Side to Side (Manual Bracket) Res Search – Control and EUT



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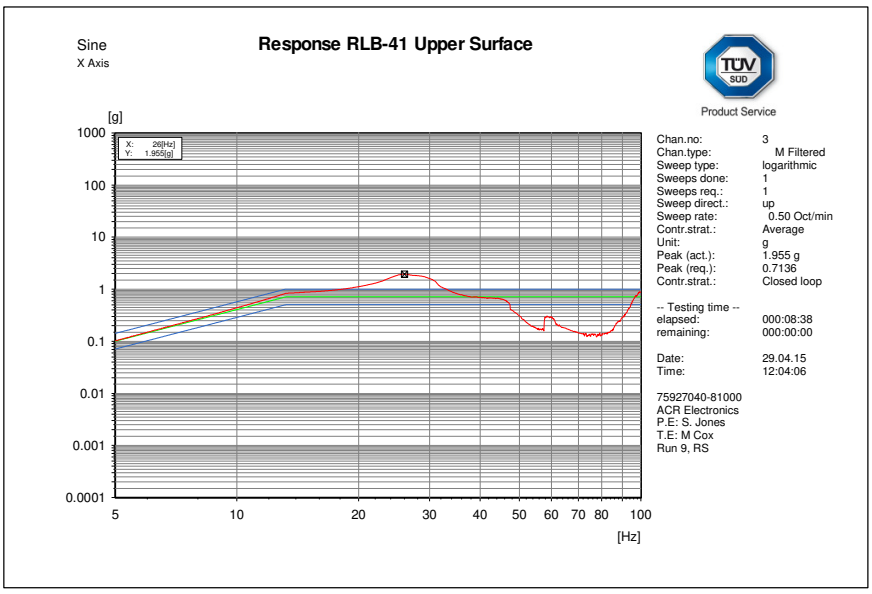

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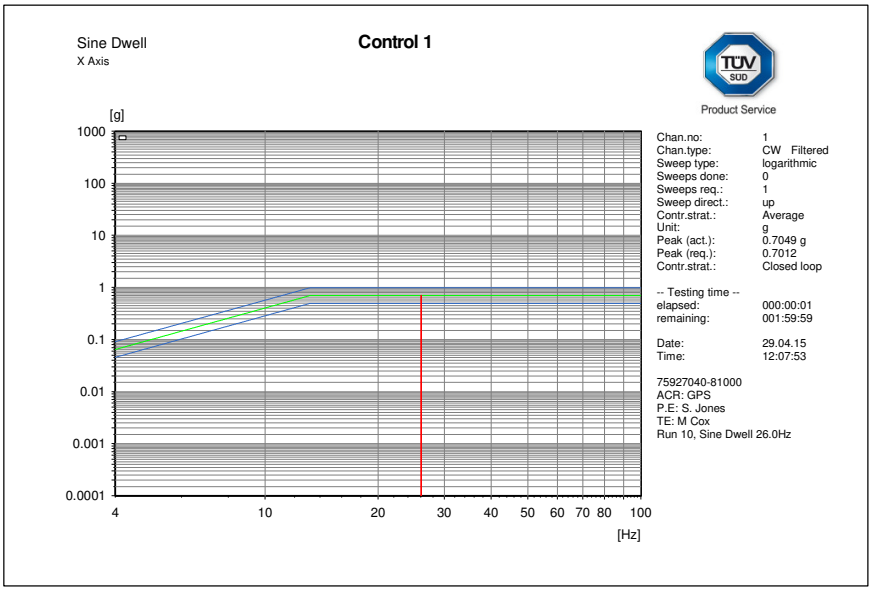
Side to Side (Manual Bracket) Endurance Run (26.0 Hz) – Control and EUT



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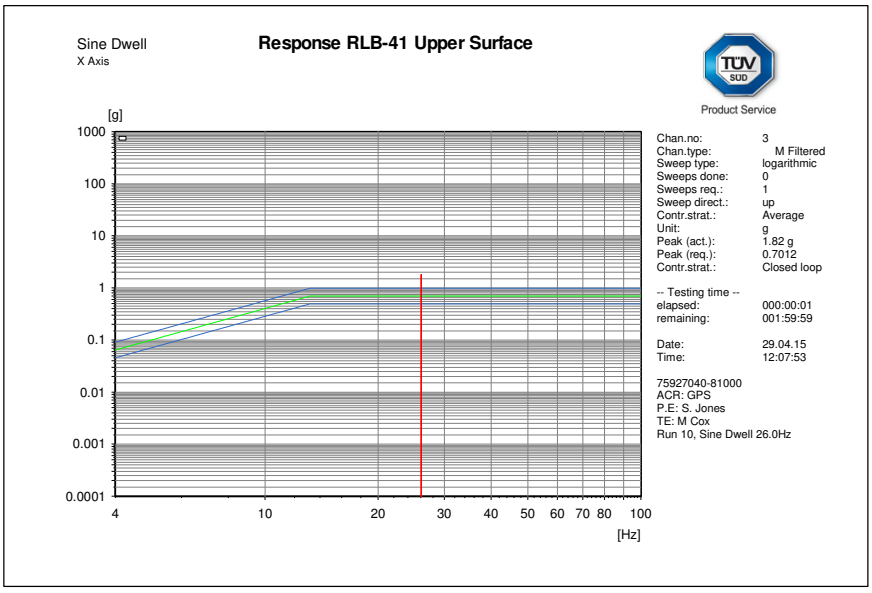

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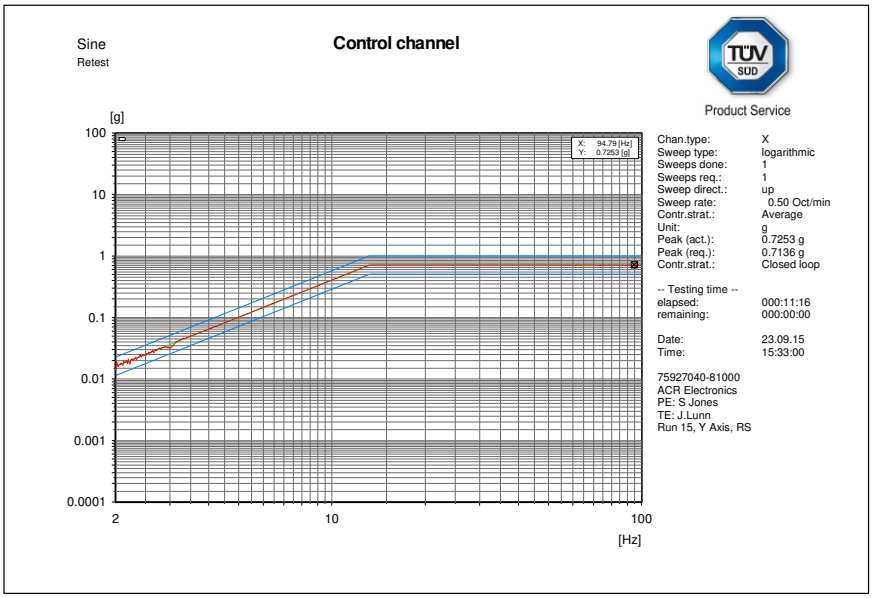
Front and Back (Manual Bracket) Res Search – Control and EUT



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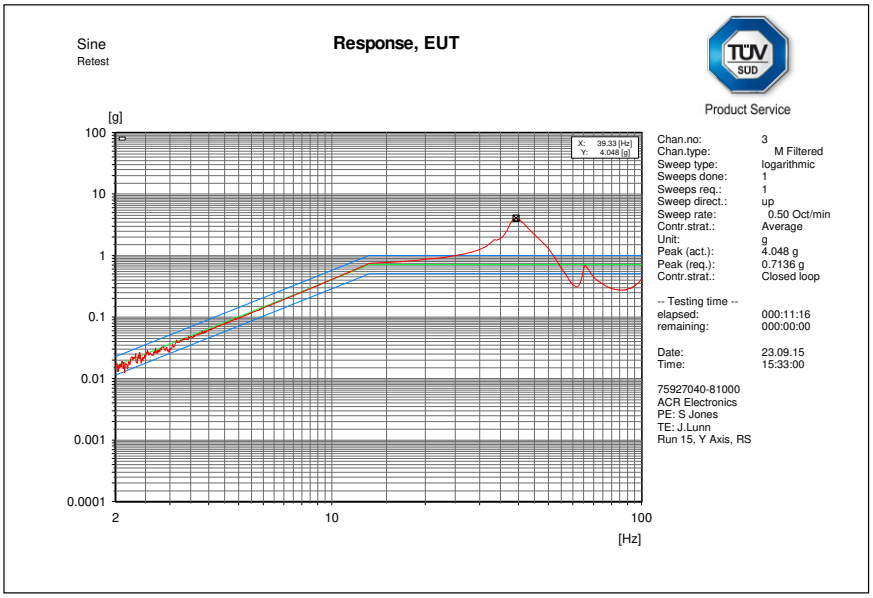

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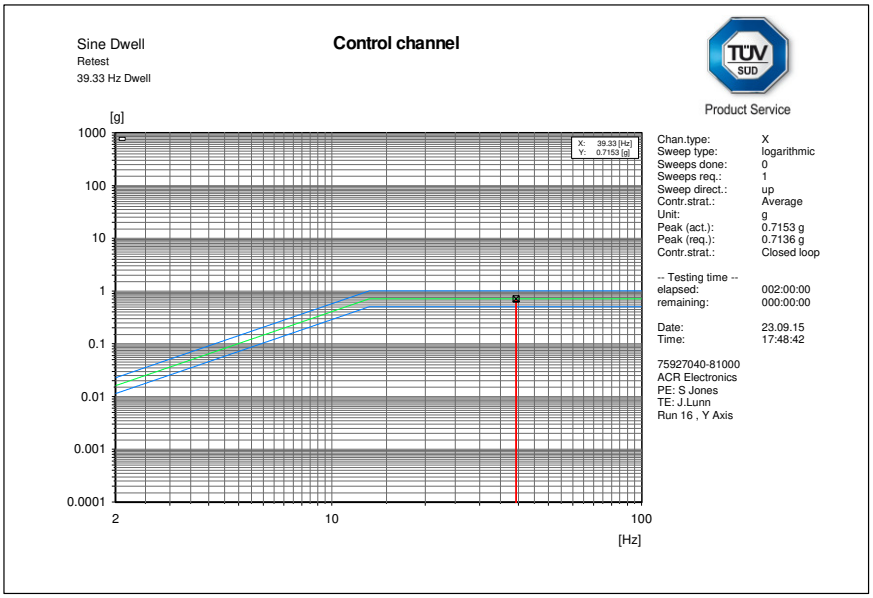
Front and Back (Manual Bracket) Endurance Run (39.33 Hz) – Control and EUT



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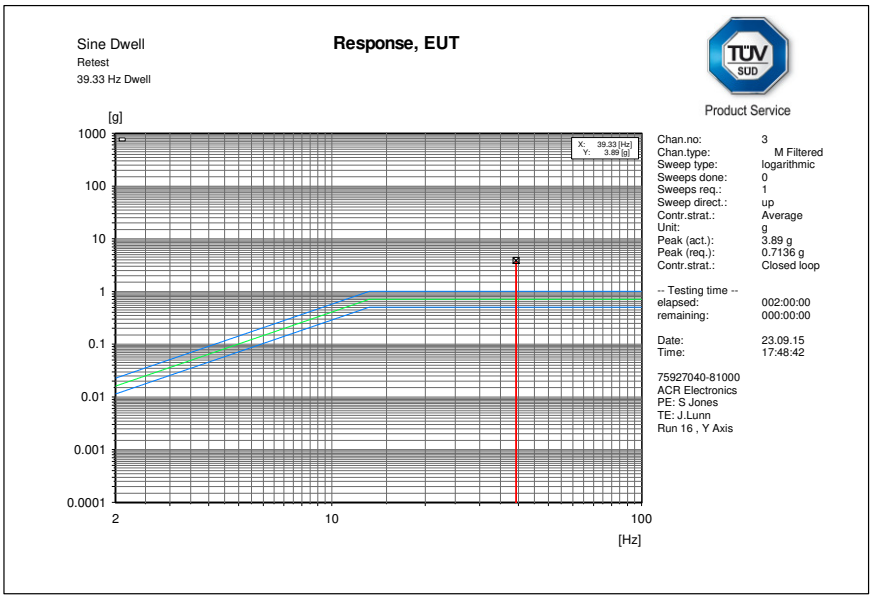

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2.4.8 Test Results

Performance Check Results

RLB-41 S/N: #9 (TUV Ref TSR0064)

Parameter	Result
Self-test Mode:	
Self-test Message	FFFED08C9EF9C0637FDFF83D15B7
Normal Mode:	
Normal Message	FFFE2F8C9EF9C0637FDFF83D15B783E0F66C
406 MHz Frequency	406.039965
121 MHz Presence	P

RLB-41 S/N: #15 (TUV Ref TSR0058)

Parameter	Result
Self-test Mode:	
Self-test Message	FFFED08C9EF9C0637FDFF83D15B7
Normal Message	FFFE2F8C9EF9C0637FDFF83D15B783E0F66C
406 MHz Frequency	406.0400
121 MHz Presence	P

Mechanical Inspection

Post test no signs of mechanical degradation were witnessed.

Activation Monitoring

During the test the EUT was monitored for signs of activation, none were found.

2.5 RUGGEDNESS

2.5.1 Specification Reference

IEC 61097-2, clause A.1.5 incorporating the requirements of RTCM 11000.3 Clause A.7

2.5.2 Equipment Under Test and Modification State

RLB-41 S/N: #15 (TUV Ref TSR0058) - Modification State 0
RLB-41 S/N: #9 (TUV Ref TSR0064) - Modification State 0

2.5.3 Date of Test

24 April 2015

2.5.4 Test Equipment Used

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

2.5.5 Environmental Conditions

Ambient Temperature 18.2 °C
Relative Humidity 47.9 %

2.5.6 Test Setup

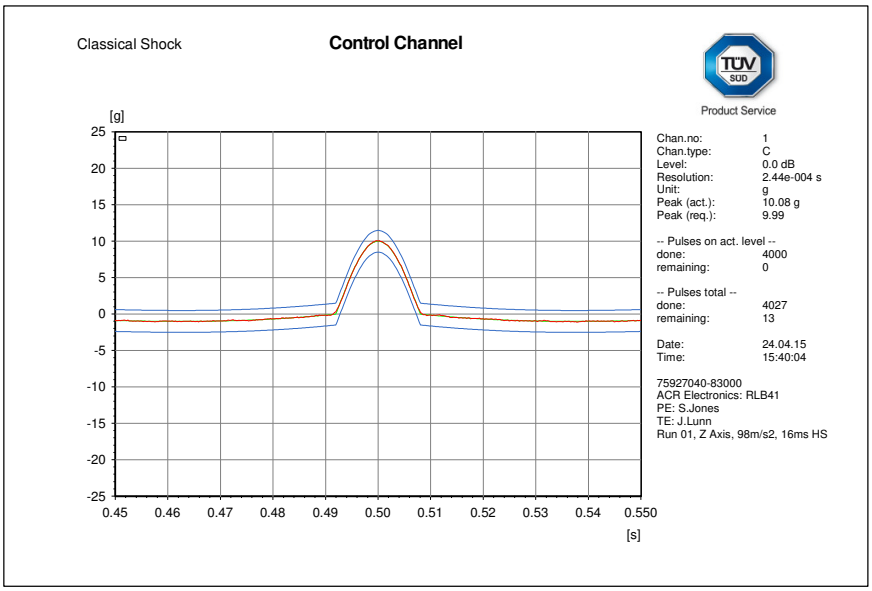
2.5.7 Test Method

The PLB was subjected to the bump test according to the following profile:

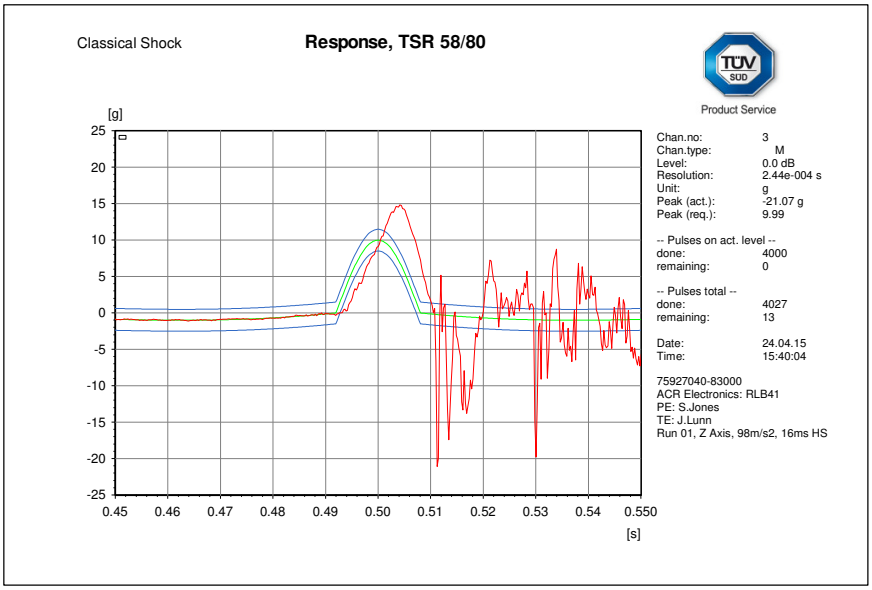
Peak acceleration: 98 m/s^2 +/-10 %
Pulse duration: 16 ms +/-10 %
Wave shape: Half-cycle sinewave
Test Axis: Vertical
Number of bumps: 4000

2.5.8 Test Results

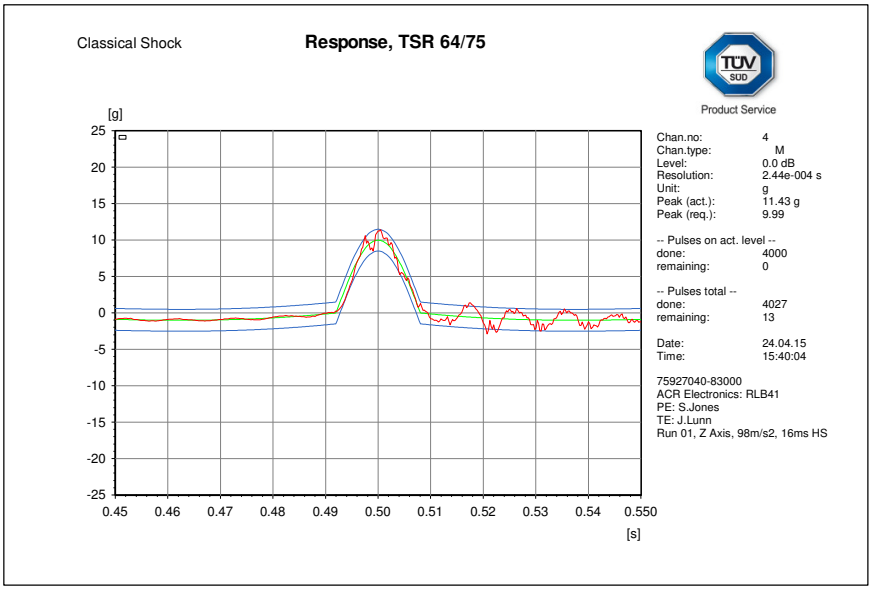
Vertical Axis, 4000 Bumps



C:\VcpNT\Daten\m+p\ACR\75927040-83000\Half Sine_008.rcs



C:\VcpNT\Daten\m+p\ACR\75927040-83000\Half Sine_008.rcs



C:\VcpNT\Daten\m+p\ACR\75927040-83000\Half Sine_008.rcs

Post Test Inspection

No signs of mechanical degradation were observed.

EUT Response

The EUT did not activate during the test.

Summary of Performance Check Results

S/N: #15 (TUV Ref TSR0058) – Conducted EUT in Manual Release Bracket

Parameter	Result
Self-test Mode:	
Self-test Message	FFFED08C9EF9C0637FDFF83D15B7
Normal Mode:	
Normal Message	FFFE2F8C9EF9C0637FDFF83D15B783E0F66C
406 MHz Frequency	406.039962
121 MHz Presence	P

S/N: #9 (TUV Ref TSR0064) – Radiated EUT in Float Free Case

Parameter	Result
Self-test Mode:	
Self-test Message	FFFED08C9EF9C0637FDFF83D15B7
Normal Mode:	
Normal Message	FFFE2F8C9EF9C0637FDFF83D15B783E0F66C
406 MHz Frequency	406.039974
121 MHz Presence	P

2.6 DROP ON HARD SURFACE

2.6.1 Specification Reference

IEC 61097-2, clause A.1.6

2.6.2 Equipment Under Test and Modification State

RLB-41 S/N: #9 (TUV Ref TSR0064) - Modification State 0

2.6.3 Date of Test

27 April 2015

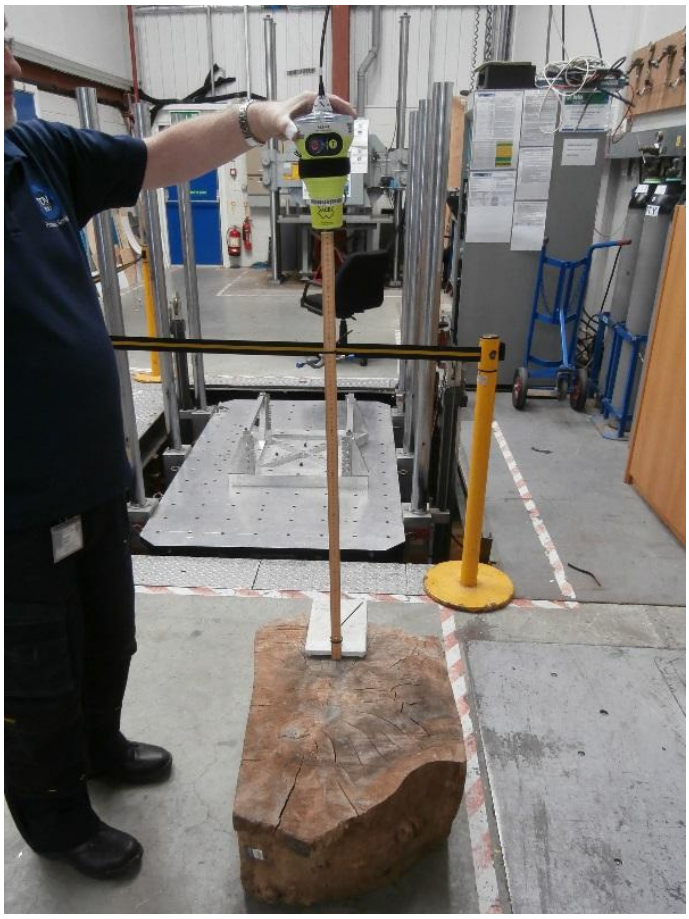
2.6.4 Test Equipment Used

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

2.6.5 Environmental Conditions

Ambient Temperature 21.5 °C
Relative Humidity 21.5 %

2.6.6 Test Setup



2.6.7 Test Method

The EUT was dropped 6 times, one on each face, from a height of 1000 mm ± 10 mm onto the test surface (solid piece of hardwood).

2.6.8 Test Results

EUT Response

The EUT did not activate during the test.

Performance Check – Post-test

Parameter	Result
Self-test Mode:	
Self-test Message	FFFED08C9EF9C0637FDFF83D15B7
Normal Mode:	
Normal Message	FFFE2F8C9EF9C0637FDFF83D15B783E0F66C
406 MHz Frequency	406.039958
121 MHz Presence	P

Examination

The EUT was subjected to an external visual examination post-test. The antenna was damaged as shown in the photograph below. It was considered that the damage could affect the functionality of the beacon.

A Satellite Qualitative test was carried out during the limited COSPAS SARSAT testing, after this test and the results were found to be compliant – see section 2.13 and Annex A for test data.

The damage to the antenna's black sleeve above was noted to worsen (split) over the following 2 days as shown in the photograph below.

2.7 DROP INTO WATER (NUA)

2.7.1 Specification Reference

IEC 61097-2, clause A.1.7

2.7.2 Equipment Under Test and Modification State

RLB-41 S/N: #9 (TUV Ref TSR0064) - Modification State 0

2.7.3 Date of Test

30 April 2015

2.7.4 Test Equipment Used

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

2.7.5 Environmental Conditions

Ambient Temperature 19.4 °C
Relative Humidity 34.9 %

2.7.6 Test Method

The EUT was dropped three times from a height of 20 m into water. The EUT was orientated once with the antenna vertically up, once vertically down, and once horizontally.

2.7.7 Test Results

Setup Photo

EUT Response

The EUT activated after each drop, when contact with the water was made and deactivated shortly after being removed from the water.

Examination

The EUT was subjected to an external visual inspection post-test and no signs of ingress or external damage were observed, the internal inspection were therefore postponed.

The EUT was inspected at the conclusion of the environmental tests and no signs of water ingress were found.

Summary of Performance Check Results

Parameter	Result
Self-test Mode:	
Self-test Message	FFFED08C9EF9C0637FDFF83D15B7
Normal Mode:	
Normal Message	FFFE2F8C9EF9C06332E0227236F796A6B046
406 MHz Frequency	406.039961
121 MHz Presence	P

Message content indicates that a position was acquired. The Performance Check was carried out outdoors, therefore ambient signals were likely detected by the EUT.

2.8 THERMAL SHOCK

2.8.1 Specification Reference

IEC 61097-2, clause A.1.8

2.8.2 Equipment Under Test and Modification State

RLB-41 S/N: #9 (TUV Ref TSR0064) - Modification State 0

2.8.3 Date of Test

11 May 2015

2.8.4 Test Equipment Used

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

2.8.5 Environmental Conditions

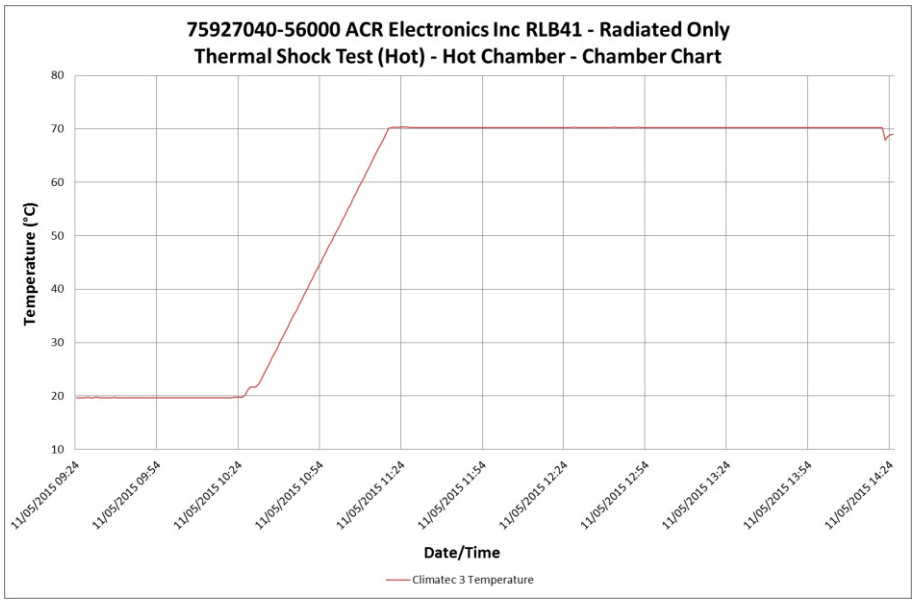
Ambient Temperature 23.2 °C
Relative Humidity 46.6 %

2.8.6 Test Method

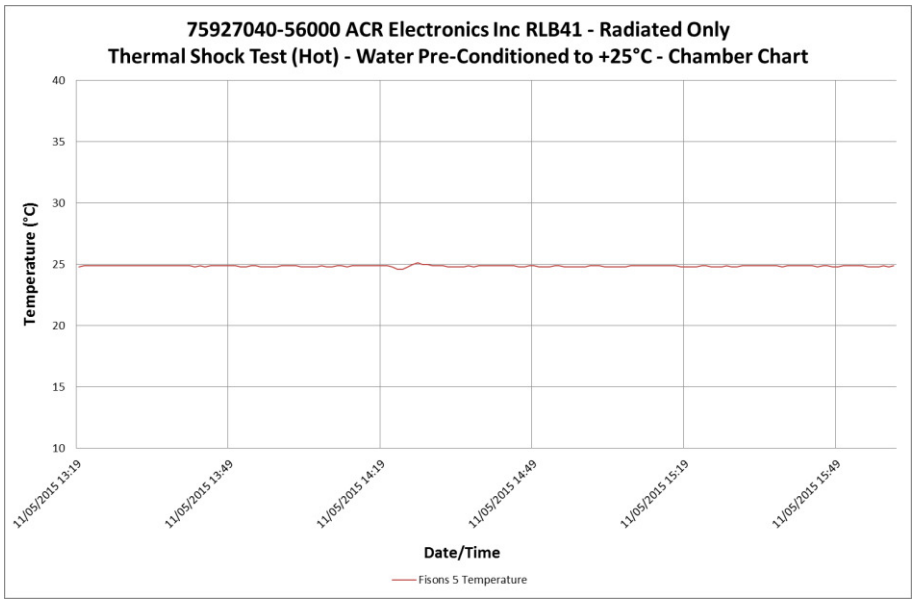
The EUT was placed in the pre-conditioning climatic chamber at a temperature of +70 °C for ≥ 1 hour.

The EUT was then immersed in water at +25 °C, 100 mm below the surface of the water (measured to the highest point of the EUT).

Preconditioning Temperature Plot



Water Temperature Plot



Setup Photo

2.8.7 Test Results

Performance Check

Parameter	Result
Self-test Mode:	
Self-test Message	FFFED08C9EF9C0637FDFF83D15B7
Normal Mode:	
Normal Message 406 MHz Frequency 121 MHz Presence	FFFE2F8C9EF9C0637FDFF83D15B783E0F66C 406.0400 P

2.9 IMMERSION

2.9.1 Specification Reference

IEC 61097-2, clause A.1.9

2.9.2 Equipment Under Test and Modification State

RLB-41 S/N: #9 (TUV Ref TSR0064) - Modification State 0

2.9.3 Date of Test

11 May 2015

2.9.4 Test Equipment Used

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

2.9.5 Environmental Conditions

Ambient Temperature 23.4 °C
Relative Humidity 46.6 %

2.9.6 Test Method

The EUT was completely submerged in a vessel of water and then positioned in an overpressure chamber. A gauge pressure corresponding to a 10 m head of water was applied for a period of 5 minutes.

2.9.7 Test Results

Setup Photo

Examination

On completion of the test the EUT was inspected. No signs of water ingress were found.

Parameter	Result
Self-test Mode:	
Self-test Message	FFFED08C9EF9C0637FDFF83D15B7
Normal Mode:	
Normal Message 406 MHz Frequency 121 MHz Presence	FFFE2F8C9EF9C0637FDFF83D15B783E0F66C 406.039965 P

Observation: the EUT failed to switch off after the immersion test. The Manufacturer advised that this was most likely caused by pressure differential between the inside and outside of the EPIRB, thus causing the membrane On/Off switch to remain in the depressed state. The EUT was switched off manually by TUV SUD engineers.

2.10 SPURIOUS EMISSIONS

2.10.1 Specification Reference

IEC 61097-2, clause A.1.10

2.10.2 Equipment Under Test and Modification State

RLB-41 S/N: #15 (TUV Ref TSR0058) - Modification State 0

2.10.3 Date of Test

18 May 2015, 8 June 2015, 12 June 2015 and 15 June 2105

2.10.4 Test Equipment Used

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

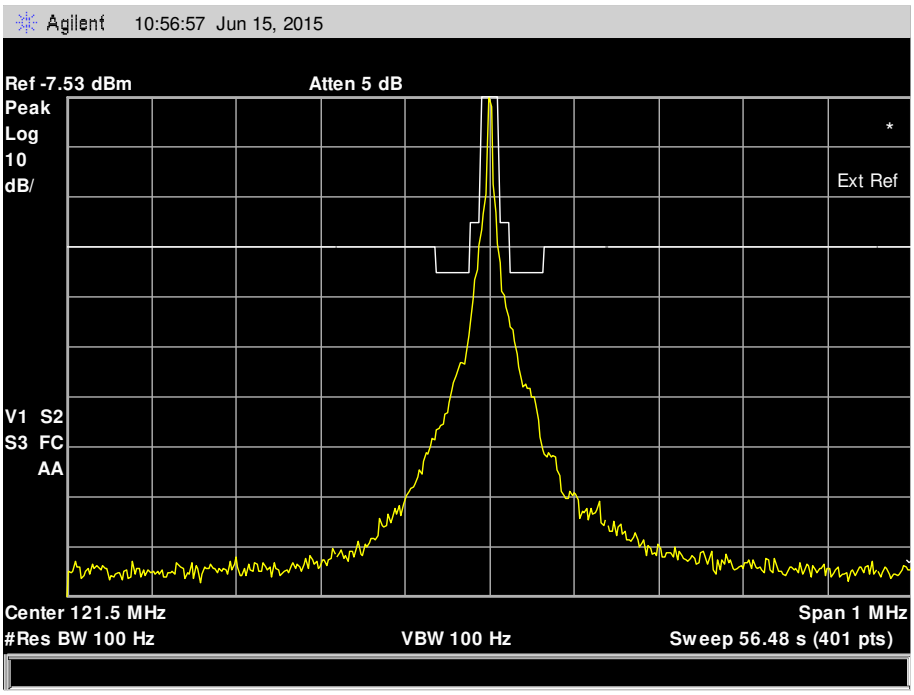
2.10.5 Environmental Conditions

Ambient Temperature 22.5 - 23.2 °C
Relative Humidity 29.1 - 30.3 %

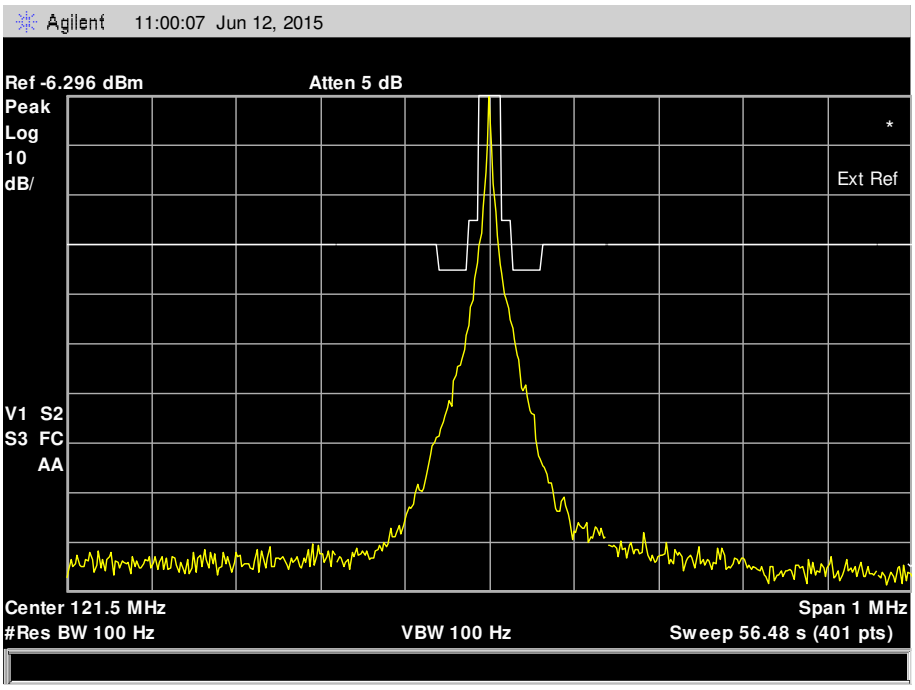
2.10.6 Test Results

121 Homing Transmitter

Minimum Temperature

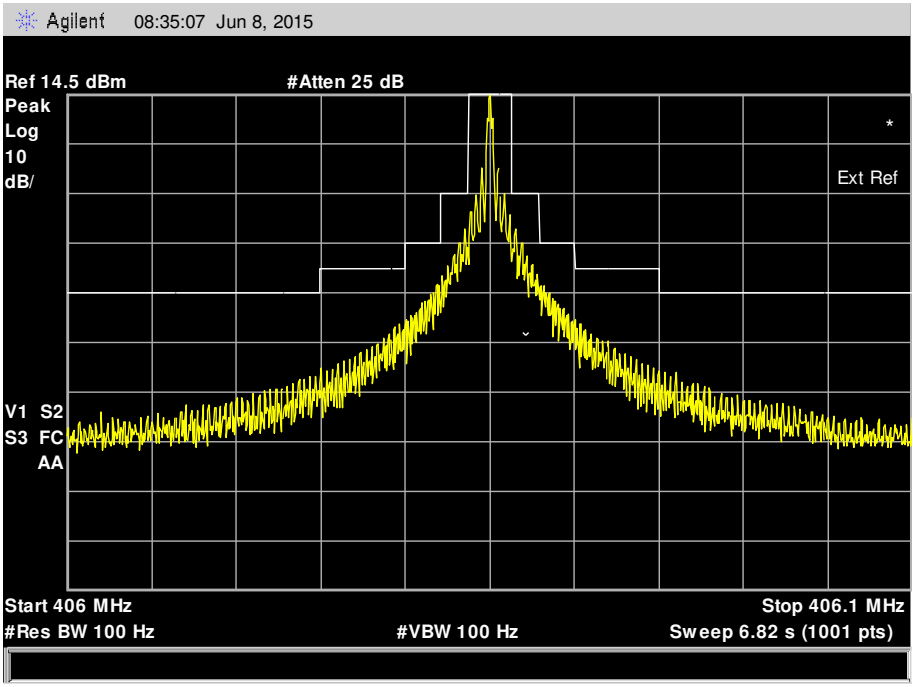


Maximum Temperature



406 Transmitter

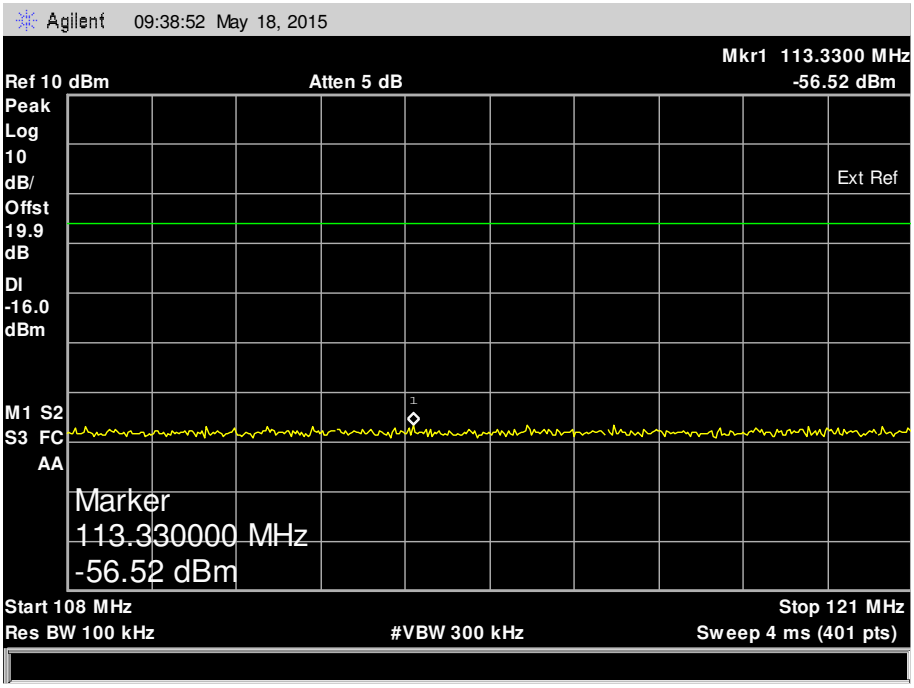
Combined Plot over Ambient, Minimum and Maximum Temperatures



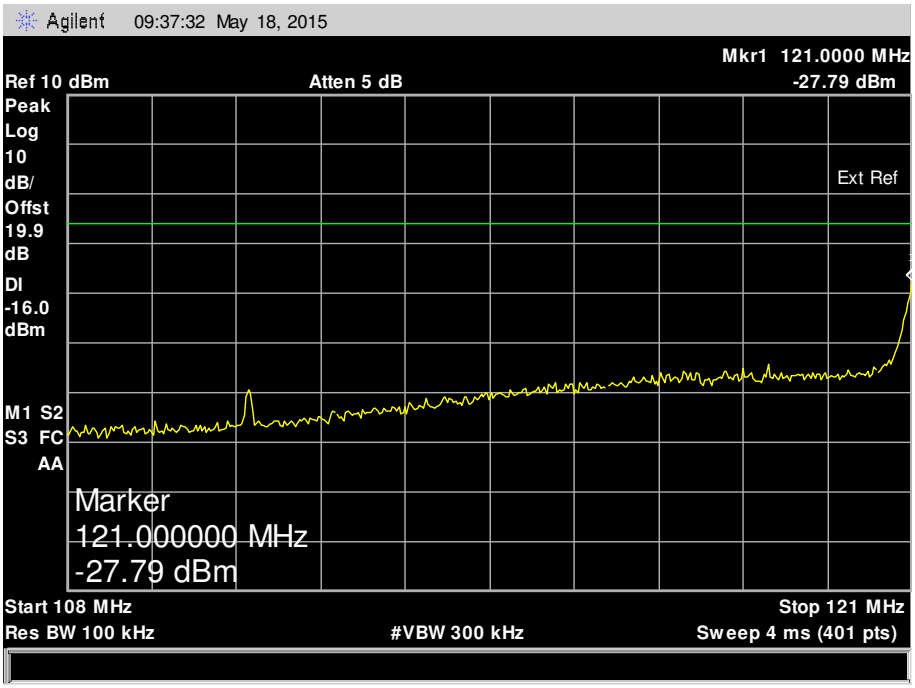
Note: Plot taken during Limited Cospas Sarsat measurements made at the end of the Environmental Test programme.

108MHz to 121MHz

406 Port

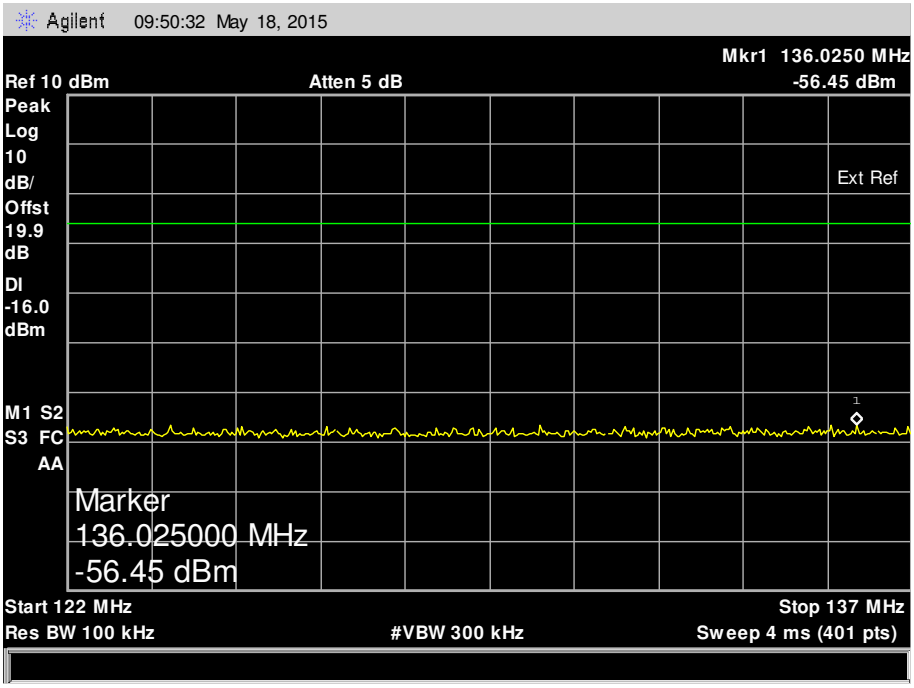


121 Port

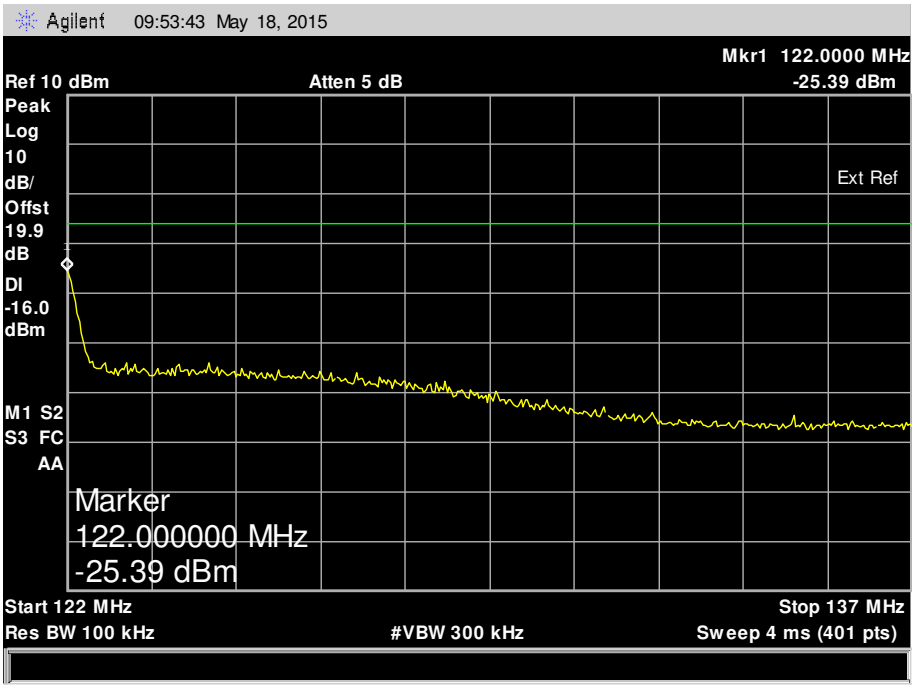


122MHz to 137MHz

406 Port

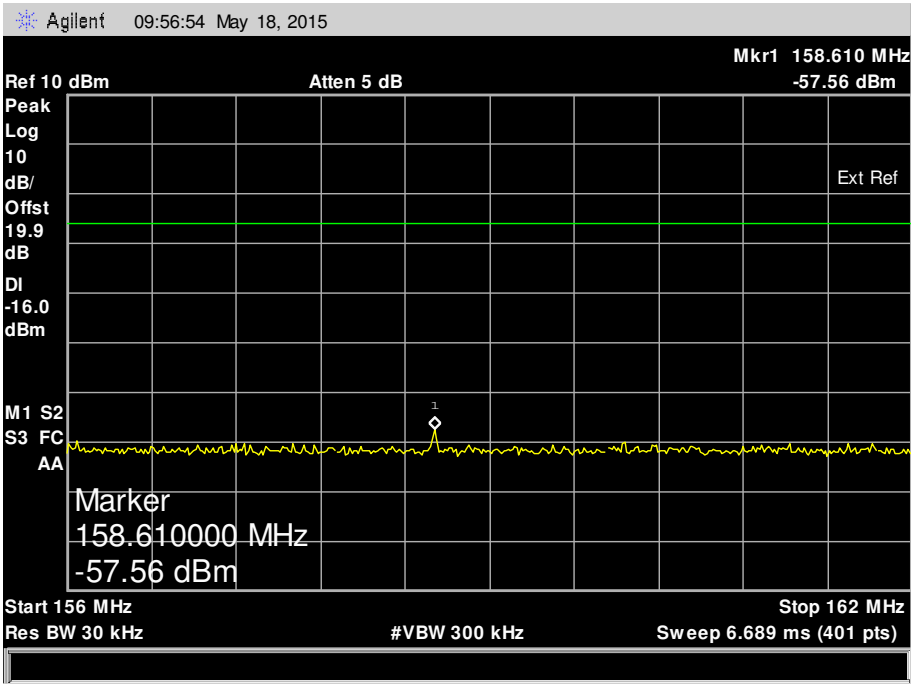


121 Port

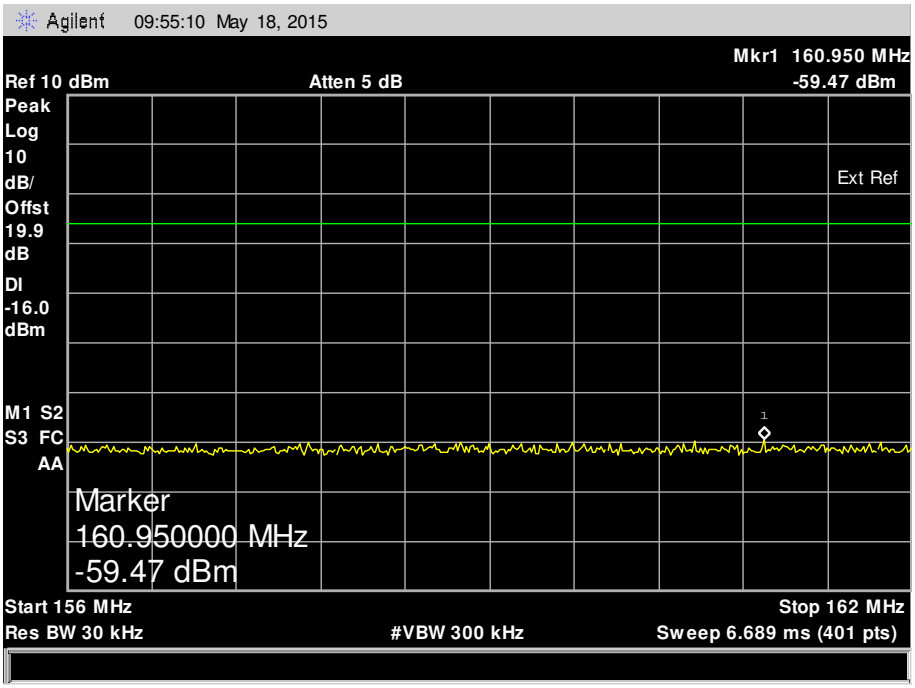


156MHz to 162MHz

406 Port

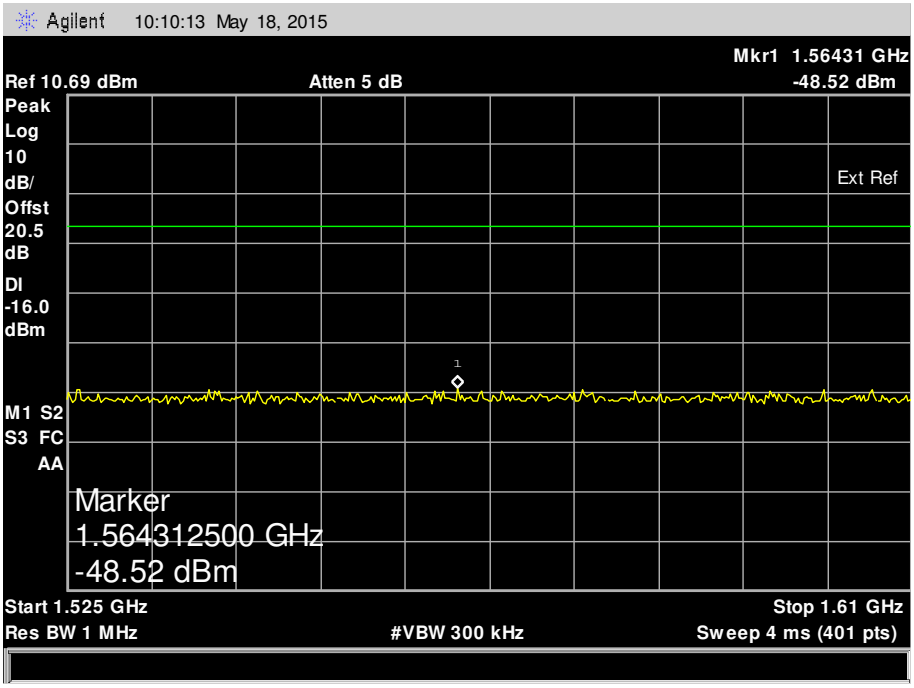


121 Port

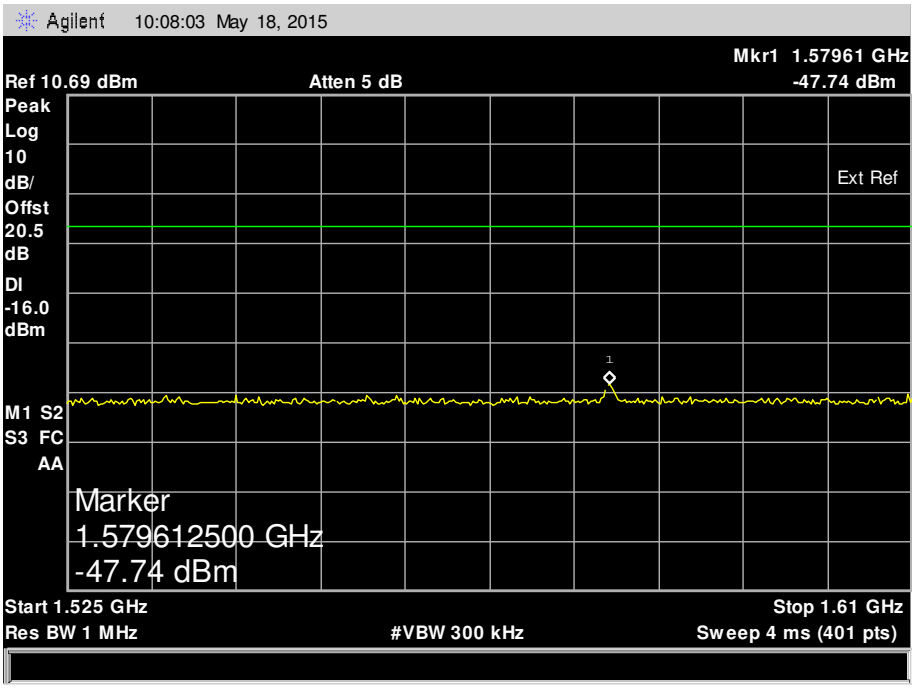


1525MHz to 1610MHz

406 Port



121 Port



2.11 BATTERY CAPACITY AND LOW TEMPERATURE

2.11.1 Specification Reference

IEC 61097-2, clause A.1.11

2.11.2 Equipment Under Test and Modification State

RLB-41 S/N: #15 (TUV Ref TSR0058) - Modification State 0

2.11.3 Date of Test

31 May 2015, 01 June 2015 and 02 June 2015

2.11.4 Test Equipment Used

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

2.11.5 Environmental Conditions

Ambient Temperature 21.1 °C
Relative Humidity 31.7 %

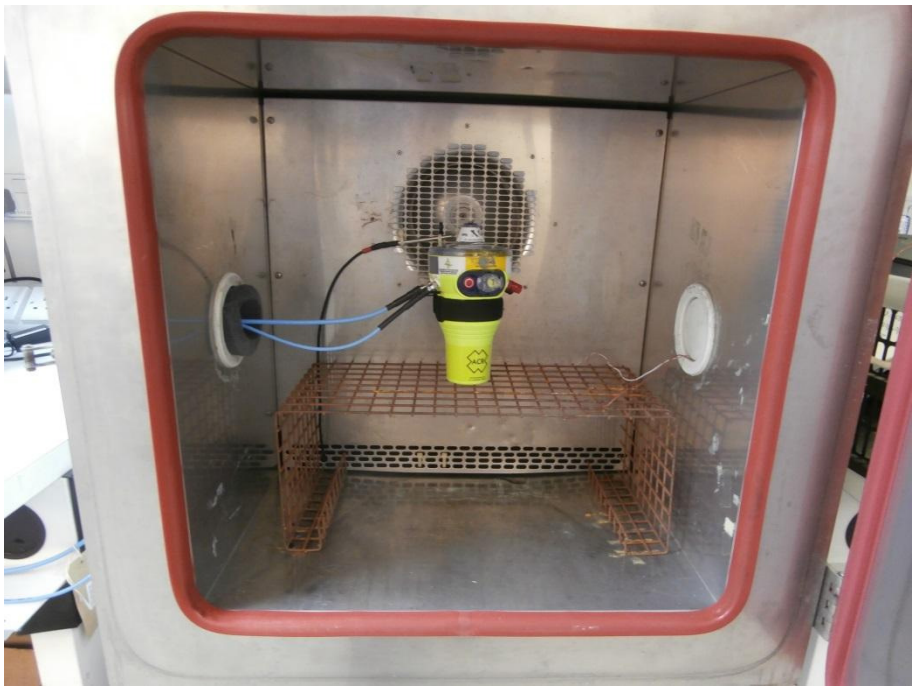
2.11.6 Test Method

The EUT was placed in a chamber; the temperature was reduced to -30 °C at ≥ 1 °C/min and held for 10 hours. The chamber temperature was increased to -20 °C over a period of 10 minutes and maintained at that temperature until the end of the test. The EUT was activated 30 minutes after the end of the 10 hour period and the Operating lifetime at minimum temperature test from C/S T.007 was performed. After 48 hours a Performance Check was performed.

2.11.7 Test Results

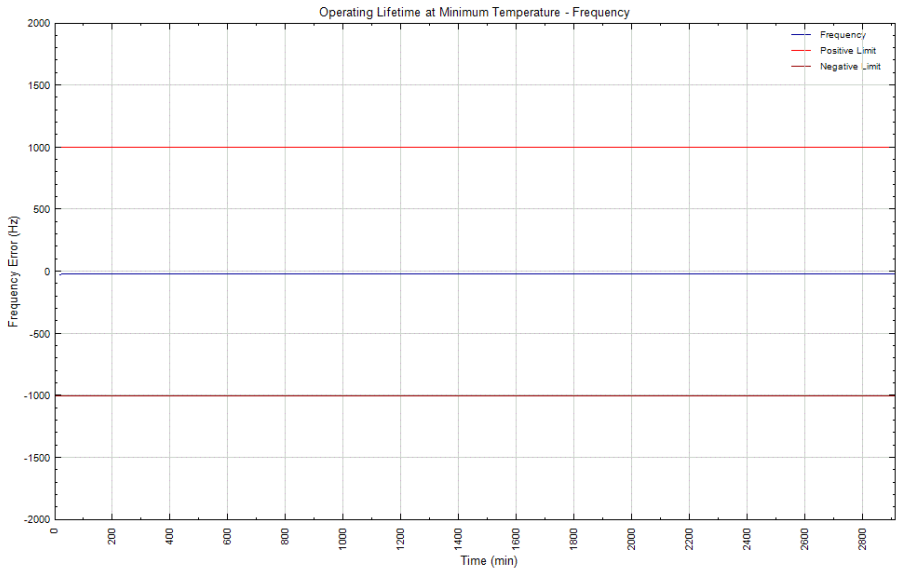
The test was performed with a fresh battery pack that had been discharged by operating for 38.4 hours. This figure was substantiated by the manufacturer.

Test Setup

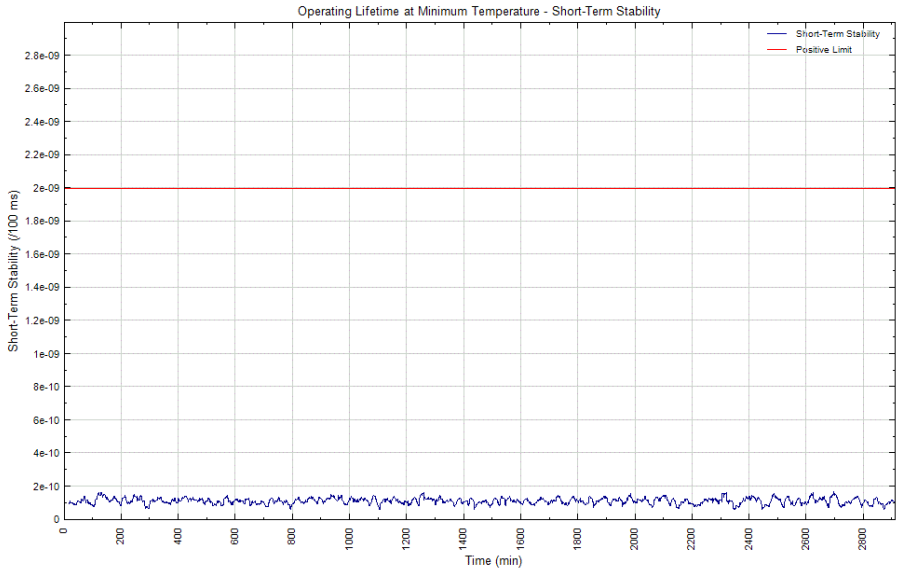


Operating Lifetime Test Results

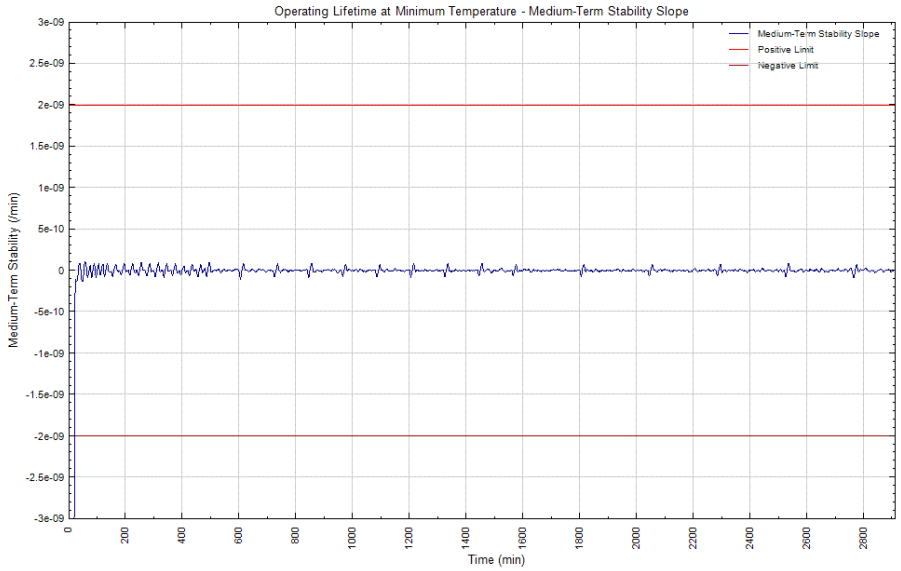
Nominal Frequency



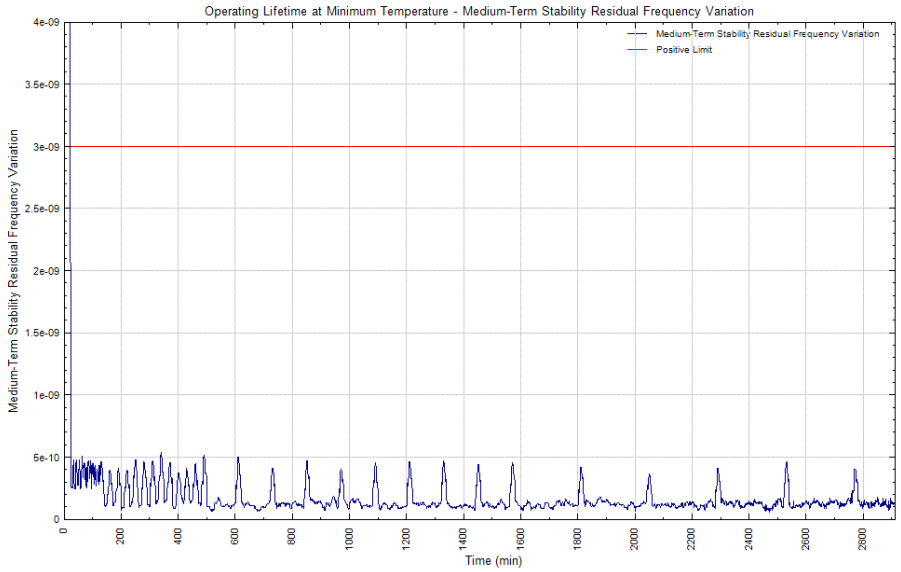
Short Term Stability



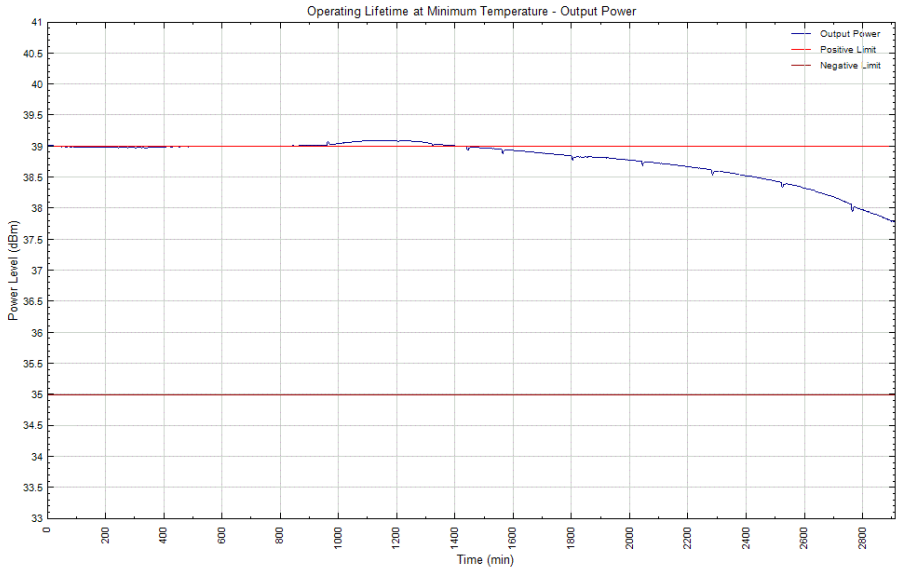
Medium Term Stability – Mean Slope



Medium Term Stability – Residual Frequency Variation



Output Power



Note: Whilst multiple output power measurements were above the upper limit, they were accepted as satisfactory per C/S T.007 Clause A.1 which states that “measurement accuracies may be added to the beacon specification limits […] allowing a slight extra margin” and that “measurement accuracy requirements […] are given in Annex A of C/S T.008”. The C/S T.008 measurement accuracy requirement for output power is 0.5 dB.

Digital Message

Message: FFFE2F8C9EF9C0637FDFF83D15B783E0F66C
Hex ID: 193DF380C6FFBFF

Parameter	Bit	Data Bits	Decoded Value
Bit synchronization	1	111111111111111	111111111111111
Frame synchronization	16	000101111	000101111
Format Flag	25	1	1
Protocol Flag	26	0	0
Country Code	27	0011001001	Albania (Republic of)
Protocol Code	37	1110	Standard Test Location Protocol
Undefined	41	11111001110000000011000 11	-
N/S	65	0	Default
Latitude Degrees	66	111111111	Default
E/W	75	0	Default
Longitude Degrees	76	1111111111	Default
BCH Code (21 Bit)	86	000001111010001010110	Correct
Supplementary Data Fixed	107	1101	1101
Encoded Position Data Source	111	1	Internal
121.5 MHz Homing	112	1	Yes
Delta Latitude +/-	113	1	Default
Delta Latitude Minutes	114	00000	Default
Delta Latitude Seconds	119	1111	Default
Delta Longitude +/-	123	1	Default
Delta Longitude Minutes	124	00000	Default
Delta Longitude Seconds	129	1111	Default
BCH Code (12 Bit)	133	011001101100	Correct

Pre-test Discharge Calculation

The calculated pre-test discharge figure of 38.35 hours was determined as per the table below; values were manufacturer-declared unless otherwise specified.

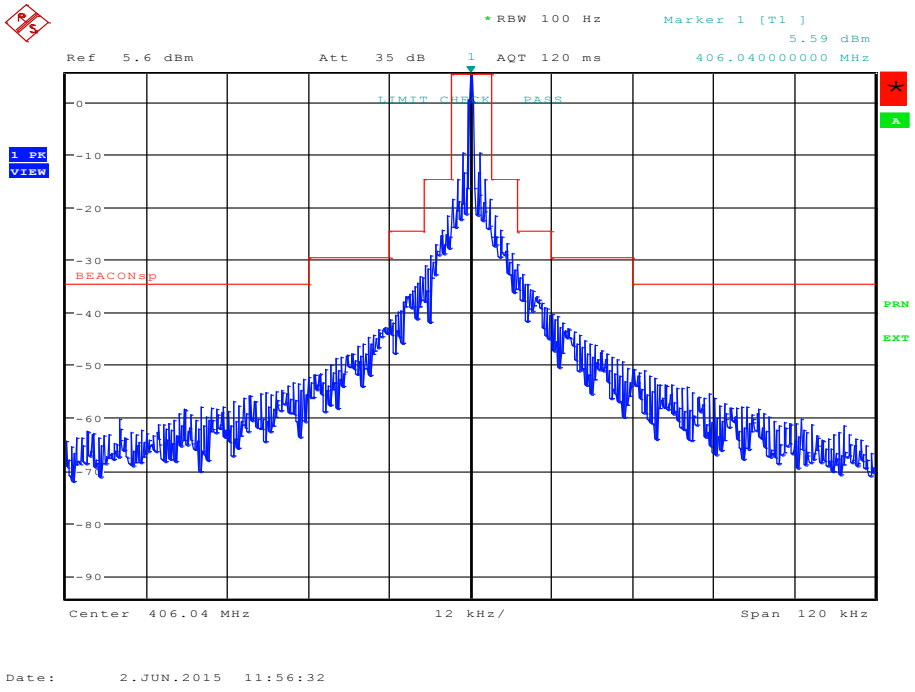
Parameter	Unit	Value	Comments
Battery capacity	mAh	4200	3 packs at 1400 mAh per pack
Self-test current	mA	79.3	
Self-test duration	s	11	
Self-tests per year	-	12	
Self-test drain / year, Q_{ST}	mAh	2.91	= Current × duration × tests per year
GNSS Self-test current	mA	25.14	
GNSS Self-test duration	s	131.68	Measured during Cospas-Sarsat Type Approval Test Procedure (see Section 2.12)
GNSS Self-tests per year	-	8.4	
GNSS Self-test drain / year, Q_G	mAh	7.72	= Current × duration × tests per year
Standby current	nA	77.46	Measured during Cospas-Sarsat Type Approval Test Procedure (see Section 2.12)
Standby drain / year, Q_S	mAh	0.68	= Standby current * hours per year
Battery self-discharge / year	% / year	1%	
Battery self-discharge / year, Q_B	mAh	42	= self-discharge × battery capacity
Useful life, t_{UL}	years	20	
Capacity loss over useful life, Q_{UL}	mAh	1066.20	= t_{UL} x (Q_{ST} + Q_G + Q_S + Q_B)
Operating current at ambient temp, I_{AMB}	mA	27.8	
Pre-test discharge	h	38.35	= Q_{UL} ÷ I_{AMB}

Performance Test

RLB-41 S/N: #15 (TUV Ref TSR0058)

Parameter	Result (Max / Min)
Output Power	37.75 / 37.71
Digital Message	FFFE2F8C9EF9C0637FDFF83D15B783E0F66C
Bit Rate	399.93 / 399.91
Modulation: Rise Time (us)	199.3 / 170.3
Modulation: Fall Time (us)	187.7 / 163.6
Positive Deviation (rad)	1.1774 / 1.0170
Negative Deviation (rad)	-1.1966 / -1.0440
Nominal Frequency (MHz)	406.0400216 / 406.0400216
Short-term Stability (/100 ms)	11.562E-11 / 11.478E-11
Medium-term Stability – Slope (/minute)	-71.225E-13 / -16.950E-12
Medium-term Stability – Residual	13.080E-11 / 12.042E-11
Spurious Emissions	See plot below

Spurious Emissions



2.12 (LIMITED) COSPAS-SARSAT TYPE APPROVAL TEST PROCEDURE

2.12.1 Specification Reference

IEC 61097-2, clause A.1.12

2.12.2 Equipment Under Test and Modification State

RLB-41 S/N: #15 (TUV Ref TSR0058) - Modification State 0
RLB-41 S/N: #9 (TUV Ref TSR0064) - Modification State 0

2.12.3 Date of Test

4 June 2015 to 17 June 2015

2.12.4 Test Equipment Used

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

2.12.5 Environmental Conditions

Ambient Temperature N/A
Relative Humidity N/A

2.12.6 Test Results

Full Cospas-Sarsat testing was carried out prior to the RTCM 11000.3 sequence of test as requested by ACR Electronics, Inc. A limited number of Cospas-Sarsat tests were repeated in order to demonstrate continuing compliance. The summary of results of the limited test campaign which was carried out as required by the sequence of tests (A.1 of 61097-2) can be found in annex A.

EUT tested in accordance with Cospas-Sarsat T.001 Issue 3 Revision 15 October 2014 and Cospas-Sarsat T.007 Issue 4 Revision 9 October 2015 and results of the full test campaign were submitted to Cospas-Sarsat Secretariat for approval.

Cospas-Sarsat Type Approval Certificate: Pending.

This is intended to show compliance with the above Specification References.

2.13 INTERFERENCE TEST (IMMUNITY TO RF)

2.13.1 Specification Reference

IEC 61097-2, clause A.1.13 (EN 60945, clause 10.4)

2.13.2 Equipment Under Test and Modification State

RLB-41 S/N: #9 (TUV Ref TSR0064) - Modification State 0

2.13.3 Date of Test

18 June 2015

2.13.4 Test Equipment Used

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

2.13.5 Environmental Conditions

Ambient Temperature 21.0°C
Relative Humidity 42.0%

2.13.6 Test Method

The test was applied in accordance with the test method requirements of IEC 61000-4-3.

The test was performed with the EUT in both Idle (Stanby) and Operating modes.

2.13.7 Test Results

For the period of test the EUT continued to operate as intended and therefore met the requirements of EN 60945.

Off/Standby Mode

Amplitude Modulation	Frequency	400Hz	
	Depth	80%	
Stepped Frequency Increments		1% with respect to last momentary frequency	
Dwell Time		3 Seconds 80MHz to 1GHz – 5sec 1GHz to 2GHz	
Frequency Range (MHz)		80 – 1000	
Field Strength (V/m)		12.6	
Frequency Range (MHz)		1000 – 2000	
Field Strength (V/m)		12.6	
		Result	
Orientation of EUT		Vertical Polarisation	Horizontal Polarisation
Front		Pass	Pass
Right Side		Pass	Pass
Rear		Pass	Pass
Left Side		Pass	Pass
Top		Pass	Pass
Underside		Pass	Pass

Operating Mode

Amplitude Modulation	Frequency	400Hz	
	Depth	80%	
Stepped Frequency Increments		1% with respect to last momentary frequency	
Dwell Time		3 Seconds 80MHz to 1GHz – 5 seconds 1GHz to 2GHz	
Frequency Range (MHz)		80 – 1000	
Field Strength (V/m)		12.6	
Frequency Range (MHz)		1000 – 2000	
Field Strength (V/m)		12.6	
		Result	
Orientation of EUT		Vertical Polarisation	Horizontal Polarisation
Front		Pass	Pass
Right Side		Pass	Pass
Rear		Pass	Pass
Left Side		Pass	Pass
Top		Pass	Pass
Underside		Pass	Pass

2.14 INTERFERENCE TEST (IMMUNITY TO ESD)

2.14.1 Specification Reference

IEC 61097-2, clause A.1.13 (EN 60945, clause 10.9)

2.14.2 Equipment Under Test and Modification State

RLB-41 S/N: #9 (TUV Ref TSR0064) - Modification State 0

2.14.3 Date of Test

22 June 2015

2.14.4 Test Equipment Used

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

2.14.5 Environmental Conditions

Ambient Temperature 21°C
Relative Humidity 42%

2.14.6 Test Method

The test was applied in accordance with the test method requirements of IEC 61000-4-2.

The test was performed with the EUT in both Off/Standby and Operating modes.

2.14.7 Test Results

Test Results

For the period of test the EUT continued to operate as intended and therefore met the requirements of EN 60945 for Immunity to Electrostatic Discharge (Enclosure Port).

Off/Standby Mode

		Contact Discharges (kV)								Air Discharge (kV)							
		2		4		6		8		2		4		8		15	
Test Points		+	-	+	-	+	-	+	-	+	-	+	-	+	-	+	-
Horizontal Coupling Plane		✓	✓	✓	✓	✓	✓	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Vertical Coupling Plane		✓	✓	✓	✓	✓	✓	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
A	Case	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	✓*	✓*	✓*	✓*	✓*	✓*	N/A	N/A
B	Power button	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	✓*	✓*	✓*	✓*	✓*	✓*	N/A	N/A
C	Test button	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	✓*	✓*	✓*	✓*	✓*	✓*	N/A	N/A
D	AE	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	✓*	✓*	✓*	✓*	✓*	✓*	N/A	N/A

Key to Results

✓ The EUT's performance was not impaired at this test point when the ESD pulse was applied.
✓* No discharge occurred at this test point when the ESD pulse was applied.
N/A Test not applicable as defined in the specification.

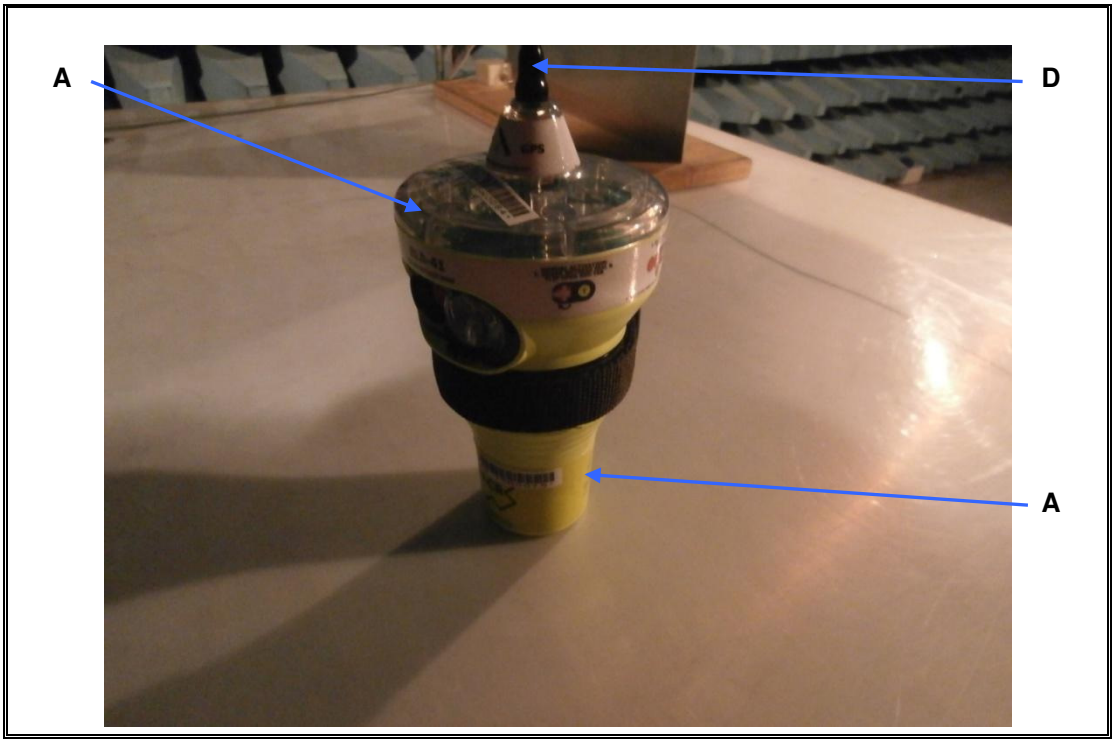
Operating Mode

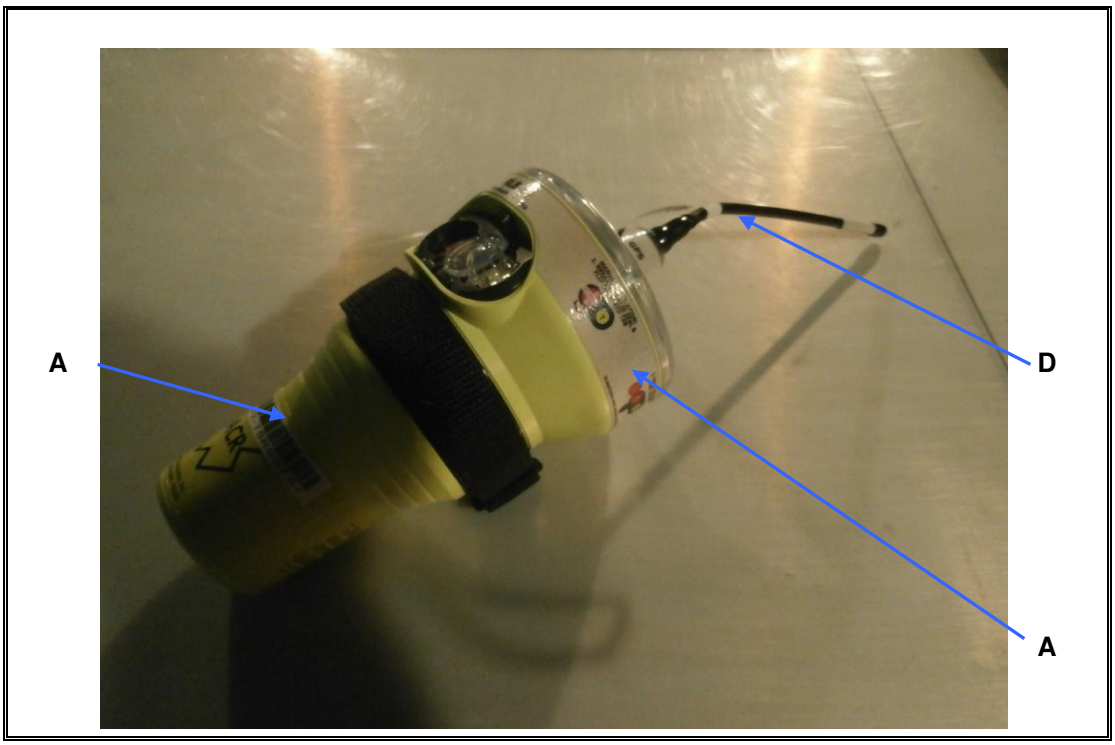
		Contact Discharges (kV)								Air Discharge (kV)							
		2		4		6		8		2		4		8		15	
Test Points		+	-	+	-	+	-	+	-	+	-	+	-	+	-	+	-
Horizontal Coupling Plane		✓	✓	✓	✓	✓	✓	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Vertical Coupling Plane		✓	✓	✓	✓	✓	✓	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
A	Case	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	✓*	✓*	✓*	✓*	✓*	✓*	N/A	N/A
B	Power button	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	✓*	✓*	✓*	✓*	✓*	✓*	N/A	N/A
C	Test button	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	✓*	✓*	✓*	✓*	✓*	✓*	N/A	N/A
D	AE	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	✓*	✓*	✓*	✓*	✓*	✓*	N/A	N/A

Key to Results

✓ The EUT's performance was not impaired at this test point when the ESD pulse was applied.
✓* No discharge occurred at this test point when the ESD pulse was applied.
N/A Test not applicable as defined in the specification.

ESD Test Points





2.15 CONDUCTED INTERFERENCE

2.15.1 Specification Reference

IEC 61097-2, clause A.1.14

The EUT does not connect to the ships power supply when installed in the release mechanism, therefore this clause is not applicable.

2.16 TEST OF OPERATIONAL REQUIREMENTS (NUA)

2.16.1 Specification Reference

IEC 61097-2, clause A.2.1 (subclauses detailed in table below).

2.16.2 Equipment Under Test and Modification State

RLB-41 S/N: #6 (TUV Ref TSR0066) - Modification State 0

2.16.3 Date of Test

2 October 2015

2.16.4 Test Equipment Used

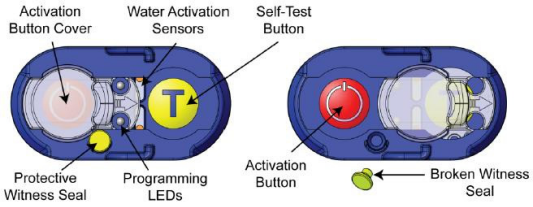
The major items of test equipment used for the above tests are identified in Section 3.1.

2.16.5 Test Results

IEC 61097-2 sub clause	Statement	Comment	Result
Clause 5.3.1 Prevention of inadvertent activation (3.3.1a – 3.3.1b)			
	a) (A.810(19)/A.2.3.1) be fitted with adequate means to prevent inadvertent activation and deactivation; b) not automatically activate when water washes over it while in its release mechanism; c) be designed to limit any inadvertent continuous 406 MHz transmission to a maximum of 45 s.	The EUT is fitted with Activation Button Cover. This must be slid over to the self test button thus breaking the witness seal and uncovering the Activation button For Inadvertent activation (hose stream) test refer to section 2.29. Refer to TUV SUD document 75927040 report 1.	- Refer to TUV SUD document 75927040 report 1.
Clause 5.3.3.2 Test for repetitive manual action and deactivation (3.3.3b)			
	The satellite EPIRB shall (A.810(19)/A.2.3.4) be capable of repetitive manual activation and manual deactivation. Manual deactivation shall not prevent automatic activation of the satellite EPIRB when automatically released from its release mechanism or when floating in the water.	The EUT can be manually switched on and off as required. After the initial manual activation the EUT witness seal will be broken (thus indicating that the Activation Button Cover has been moved). When placed in water the EUT will automatically activate. Once the water contacts are dried the EUT should deactivate.	-
5.3.3.4 Tests for 3.3.3d to 3.3.3f			
	d) When the satellite EPIRB is manually activated, the low-duty cycle light (see 3.3.3 c)) shall begin flashing within 2 s, in any lighting condition, and no distress signal shall be emitted until at least 47 s and at most 5 min after the satellite EPIRB has been manually activated. e) After start of transmission of the distress signal, the operation of the low-duty cycle light should be in accordance with 3.3.3 c). f) The satellite EPIRB shall (A.810(19)/A.2.3.5) be provided with means to indicate that signals are being emitted. The low-duty cycle light operating in accordance with 3.3.3 c), is an acceptable indication.	Refer to subcontractor (Opti Consulting Limited) report OC-0522-01.	-

5.3.4 Self test (3.3.4)			
	The satellite EPIRB shall (A.810(19)/A.2.3.8) be capable of being tested, without using the satellite system, to determine that the satellite EPIRB is capable of operating properly. When the self-test mode (see C/S T.001) is activated, the satellite EPIRB shall emit a single modulated burst which shall always provide the beacon 15 Hex ID. The frame synchronization pattern shall be "011010000" (i.e. the last eight bits are complemented so that this test burst will not be processed by the satellite equipment and the burst duration shall be 440 ms or 520 ms). For location protocol beacons, the content of the encoded position data field of the self-test message should be the default values specified in C/S T.001. Successful completion of the test shall be indicated. Activation of the test facility shall reset automatically. The 121,5 MHz auxiliary radio-locating device signal shall also be transmitted during the self-test, but it shall not exceed 3 audio sweeps or 1 s, whichever is greater. The self-test function shall perform an internal check and indicate that RF power is being emitted at 406 MHz and at 121,5 MHz.	The EUT provides a self test function. This is denoted on the EUT by a button labelled *T*. The user manual notes: *Self-test checks battery capacity, beacon memory, 406 MHz and 121.5 MHz RF tests, GPS, and the board circuit. During self-test a 406 MHz self-test message and 121.5MHz signal are transmitted from the beacon. A long green LED flash and a long beep indicate a successful test. If any of the individual tests fail during self-test there will be a long red LED flash and four (4) beeps. The strobe light will flash at the end of self-test and the self-test will be complete at that point.* Once the self test is complete the EUT returns to the normal state (i.e. off and capably of being activated). Refer to TUV SUD document 75927040 report 01 for C/S test results. The 121.5 MHz signal is transmitted during the self test and does not exceed 3 audio sweeps.	-

5.3.5 Colour and retro-reflecting material			
	The satellite EPIRB shall (A.810(19)/A.2.3.9) be of highly visible yellow/orange colour and be fitted with retro-reflecting material. The minimum area of retro-reflective material visible above the water-line of the satellite EPIRB shall be at least 25 cm2. This shall be achieved by retro-reflective material, at least 25 mm wide, with at least 5 cm2 viewable from every angle on the horizon. The retro-reflective material shall also meet the performance requirements of IMO Resolution A.658(16) Annex 2.	The main body of the EUT is the standard ACR equipment colour (ACR Artreuse). The area of retro-reflective material above the waterline was measured as approximately 15 cm^2. In some parts of this 15cm^2 retro-reflective material additional detail (writing / diagrams etc) is printed on top. There are two additional retro reflective bands which are included on the top and bottom of the antenna (approximately 14.5 cm^2). The total amount of retro reflective material above the waterline is therefore approximately 29.5cm^2. There is additional retro-reflective material below the waterline (at least another 15cm^2), also including additional detail on top. The manufacturer advises that the following documents provide additional information relating to the retro reflective material A2-05-0180 A A3-06-2858 C 3 M Scotchlite Reflective materials SOLAS Grade Products Technical Data Sheet Sept 07 (page 1 included in Annex B).	-
5.3.6 Lanyard (3.3.6)			
	The satellite EPIRB shall (A.810(19)/A.2.3.10) be equipped with a buoyant lanyard, firmly attached to it, suitable for use as a tether for survivors or from a survival craft in the water. It shall be so arranged as to prevent its being trapped in the ship's structure when floating free. 5.3.7The buoyant lanyard shall have a length of 5 m to 8 m. The breaking strength of the lanyard and its attachment to the satellite EPIRB shall be at least 25 kg.	The EUT is equipped with a lanyard. The lanyard is wrapped around the beacon body and can be found under the Velcro wrist strap. When shipped from the manufacturer the lanyard has an additional plastic wrap, which is easily removed, together with the location of the lanyard and the Velcro cover the likelihood of being trapped is reduced when in its normal stowage condition. The lanyard was measured as being 6.8m in length. The lanyard, when affixed to the EUT via the mounting point and around the beacon body was capable of lifting 25 kg.	–
5.3.7 Exposure to marine environment (3.3.7)			
	The satellite EPIRB shall not (A.810(19)/A.2.3.12), including the labelling, be unduly affected by sea water or oil or both; and (A.810(19)/A.2.3.13) be resistant to deterioration in prolonged exposure to sunlight.	Refer to Annex B for Solar and Oil Corrosion. Refer to section 2.22 for Corrosion test.	–

5.3.8 Ergonomics (3.3.8)			
	The satellite EPIRB shall have all controls of sufficient size for simple and satisfactory operation and also be capable of being operated by a person wearing an immersion suit as defined in the IMO Lifesaving Appliance Code (Resolution MSC.48(66), section 2.3). This shall include removing the EPIRB from its bracket, manual activation and deactivation of the control function and deployment of the lanyard.	When wearing an immersion suit glove it is possible to remove the EUT from the manual housing bracket and float free housing and activate the EUT. It is also possible to deactivate the EUT and deploy the lanyard when wearing an immersion suit glove.	–
5.4 Distress function (3.4)			
	(A.810(19)/A.3.1) When the satellite EPIRB is manually operated a distress alert shall be initiated only by means of a dedicated distress alert activator: The dedicated activator shall: a) (A.810(19)/A.3.2.1) be clearly identified; and b) (A.810(19)/A.3.2.2) be protected against inadvertent operation. (A.810(19)/A.3.3) Manual distress alert initiation shall require at least two independent actions neither of which on its own shall activate the satellite EPIRB. The following actions shall not be counted as one of the two independent actions required to activate the satellite EPIRB – breaking a seal or other means provided to comply with 3.3.9; – manual removal from the bracket; or – inversion. (A.810(19)/A.3.4) The satellite EPIRB shall not be automatically activated after being manually removed from the release mechanism (dry EPIRB condition).	The EUT has two buttons, these are identified as the Activation and Self test buttons. The Activation button uses a familiar power button symbol and is red in colour:  The EUT is fitted with Activation Button Cover. This must be slid over to the self test button in order to gain access to the Activation button. The Activation button must then be depressed for 5 seconds in order to activate the EUT. These two actions (slide and press) are the two independent means. The witness seal and removal from a bracket are other actions which may be required depending on installation. The EU (assuming it is not immersed in water) does not automatically activate when removed from the release mechanism.	–

5.5.1.1 Test to prevent release when sea water washes over the unit			
	The unit consisting of the satellite EPIRB and its release mechanism installed in its bracket, if any, shall be mounted, on a suitable test fixture, successively in each method intended for mounting on a ship, as described in the equipment manual. A stream from a hose shall be directed at the unit for a period of 5 min. The nozzle of the hose shall have a nominal diameter of 63,5 mm and a water-delivery rate of approximately 2 300 l of water per minute. The end of the nozzle shall be 3,50 m away from the satellite EPIRB and 1,50 m above the base of the antenna. The nozzle or the unit shall be moved during the test, so that water strikes the satellite EPIRB in an arc of at least 180° perpendicular to the normal mounting position of the unit. The satellite EPIRB shall not release from its bracket nor shall it automatically activate as a result of the water from the hose stream.	Refer to section 2.29 for Hose Stream test.	Refer to section 2.29
5.5.1.2 Construction materials			
	By test (see 5.17.11) or by inspection of the evidence submitted by the manufacturer that the materials used, including any coloured external coating, have been previously tested and are unlikely to cause any malfunction of the unit. By test (see 5.17.9, 5.17.10 and 5.17.11) or by inspection, including the labelling, of evidence submitted by the manufacturer that the materials used have been previously tested and are unlikely to be duly affected by seawater or oil or prolonged exposure to sunlight.	Refer to Annex B for Solar and Oil Corrosion. Refer to section 2.22 for Corrosion test.	-
5.5.2 External power or data connection (3.5.2)			
	(A.662(16)/3) For the satellite EPIRB requiring external power or data connection, or both, the means of connection shall not inhibit the release from the release mechanism or activation of the satellite EPIRB.	Not applicable.	-
5.5.3 Ability to check the automatic release (3.5.3)			
	(A.662(16)/4) With the exception of disposable hydrostatic release units, it shall be possible to assess the proper functioning of the automatic release mechanism by a simple method without activation of the satellite EPIRB.	The float free case can be manually opened; this does not cause the EUT to activate. Pictorial instructions are supplied for placement alongside the housing.	-

5.5.4 Manual release (3.5.4)			
	(A.662(16)/5) It shall be possible to release the satellite EPIRB manually from the float-free mechanism, without tools.	It is possible to manually release to the EUT from the float free housing.	-
5.15.2 Expiry date indication			
	-	The EUT battery body labels provide provision for the battery expiry date, the user is required to complete this inforation.	-
5.15.3 Reverse polarity protection			
	-	Whilst the battery pack is user replaceable, it is keyed and can only be fitted one way.	-
3.11 Equipment manual			
	Adequate information, as needed to comply with 3.9 and 3.13, shall be provided to enable the equipment to be properly stowed, installed, operated and tested. The information supplied with the satellite EPIRB shall include pictorial operating instructions on a waterproof placard, suitable for mounting on a bulkhead. Numerals may be used to indicate the order of the illustrated operations, but words should not be used as part of the instructions.	See relevant section for inspection against clause 3.9 and 3.13 (Maintenance and Installation). A waterproof adhesive pictorial guide is provided.	-

3.11 Equipment manual			
	The equipment manual shall also include: – an overview of the COSPAS-SARSAT system; – complete instructions for the operation and the self testing of the satellite EPIRB; – cautions and recommendations to prevent false alerts; – instructions for licensing and registration, registration renewal and a discussion on the importance of accurate registration; – battery information including replacement instructions, battery type, and safety information regarding battery use and disposal; – an instruction to replace the battery after the satellite EPIRB is operated for any purpose other than a test; – the minimum operating life-time and operating and stowage temperatures; – the purpose of the lanyard and a precaution against using it to secure the satellite EPIRB to the ship; – a recommendation against attempting to operate the satellite EPIRB inside a life raft or under any similar cover or canopy; – the servicing and/or replacement of any hydrostatic release unit and any associated components subject to ageing, such as release rods; – manufacturer recommendations, if any, on periodic functional testing, possibly in connection with battery replacement; – a note to keep the original satellite EPIRB packaging, since it may be needed if the EPIRB has to be shipped for servicing. UN requirements for shipping some batteries as hazardous goods require certain packaging standards and labelling; – instructions for the safe transportation or shipping of the satellite EPIRB or the location where such information can be obtained by the user; – warranty information; – a warning to the effect that the Satellite EPIRB shall not be operated except in an emergency; – a warning against installation near strong magnetic fields, if that might activate the satellite EPIRB; – a recommendation to mounting the satellite EPIRB as high as possible, especially on small vessels. This will help ensure operation of the hydrostatic float-free release unit, in the event the vessel capsizes without sinking; – a recommendation to limit self-testing to the minimum necessary to ensure confidence in the operation of the satellite EPIRB;	The Operating manual and labels were reviewed to confirm the following clauses were addressed. Whilst the contents of the manual were checked for inclusion the accuracy of details were not confirmed: Overview of the COSPAS-SARSAT system Operating instructions Self test instructions How to prevent false alarms How to report a false alarm Beacon registration (full advice for USA and basic advise for non USA registration) Beacon registration in the case of change of ownership Battery information (type, part number, battery change instructions, warning. Disposal guidance should be taken from regional authorities) Battery replacement is required after use Operating and Stowage temperatures Operational lifetime Recommendation not to operate the beacon inside a life raft or under a canopy. Recommendation to replace the HRU every two years. Installation instructions for replacement HRU. Recommendation to perform monthly self test. (User manual states that the Self test includes a battery capacity test). Battery shipping guidance Warranty (Limited) information Not to mount near magnetic areas To give clear view to the sky Other related comments / observations: The EUT does not support external GNSS input. The manual states that the lanyard should not be tethered to the ship (Rev T4 as supplied 21 October 2015). The manual includes a recommendation to retain the original packaging (Rev T4 as supplied 21 October 2015). The manual states *Do not activate the beacon if you have any other means of self-rescue*	-

3.11 Equipment manual			
	– a warning to limit testing to the first five minutes of the hour, as the satellite EPIRB emits a 121,5 MHz signal during self-test; – if appropriate a list of approved external GNSS Receivers for those satellite EPIRBs accepting external navigation inputs together with instructions for connecting and setting up the external devices; – if appropriate for those satellite EPIRBs with an integral GNSS receiver or that can be interfaced with an external GNSS receiver, information to guide the operator towards maximizing self-locating performance including a warning not to obstruct the GNSS antenna's view of the sky. The equipment manual shall include information explaining the necessity to report satellite EPIRB false alarms by the most expedient means to the nearest search and rescue authorities. The information that should be reported includes the satellite EPIRB 15-Hex ID; date, time, duration and cause of activation; and location at time of deactivation.	The manual recommends that the EUT should be mounted as high as possible (Rev T4 as supplied 21 October 2015). The manual provides a recommendation for the maximum number of self tests (Rev T4 as supplied 21 October 2015). The manual recommends that the self test should be limited to the first five minutes of the hour (Rev T4 as supplied 21 October 2015). The user manual advises, that in the event of an emergency, the following should be reported: The EPIRB 15-digit Unique Identifier Number (UIN) on the label on the side of the beacon. Time and date of activation Duration and cause of activation Location of beacon at the time of activation	-
3.12 Labelling			
	The label or labels shall be placed on the satellite EPIRB itself and on its container, if any, as needed. (A.810(19)/A.4) In addition to the items specified in IMO Resolution A.694(17) 6.3 and 9 (see appropriate clauses of IEC 60945) on general requirements, the following shall be clearly indicated on the exterior of the equipment: a) (A.810(19)/A.4.1) brief operating instructions at least in English, to enable manual activation, deactivation and self-test (see 3.3.4); b) a warning to the effect that the satellite EPIRB shall not be operated except in an emergency; c) type designation and class (see Clause 1, note) as specified by the manufacturer, type of battery and (A.810(19)/A.4.2) expiry date for the primary battery used (see 4.6). Means shall be provided to change this date when the battery is replaced;	The EUT labels include the following information: Basic operating instructions (including activation, deactivation and self test). Warning to only use in situations of grave and imminent danger. Category of EUT Class of EUT Provision for battery expiry date. Provision for vessel name. Provision for UIN Country code Recommendation to give a clear view to the sky (relating to GPS) Warning to test in the first 5 minutes of the hour If a battery pack is changed the new battery pack will be provided with a new label.	-

3.12 Labelling			
	d) the name of the ship and beacon identification data: 1) (A.810(19)/A.4.3) the identity code programmed into the transmitter of the satellite EPIRB (i.e. hexadecimal representation of bits 26 to 85 of the digital message, as described in C/S T.001), together with the call sign or MMSI of the ship as required by the Administration and the MID; 2) country (i.e. name of country as programmed in the MID); 3) a space for registration information (for instance Decals) as required by administrations; e) if applicable, for those satellite EPIRBs with an integral GNSS receiver or that can be interfaced with an external GNSS receiver, a statement that the device either contains a GNSS receiver or may be interfaced to one and, if necessary, brief operating instructions relevant to this feature; f) a warning to limit testing to the first five minutes of the hour, as the satellite EPIRB emits a 121,5 MHz signal during self-test.		-
	3.12.2 Float-free arrangement labelling (A.662(16)/2.9) The float-free arrangement shall carry a label or labels indicating clearly at least in English: a) the operating instructions for manual release; b) the type designation; c) the satellite EPIRB class; d) the maintenance and/or replacement date for the release mechanism, if applicable. If this label or labels are not readily visible in the installed arrangement, they shall be provided in addition, for installation close to the float-free arrangement. These instructions may in addition be shown in pictorial form.	The float free housing labels include the following information: Pictorial instructions for manual release (bulkhead label) A1-20-1007JDASH has provision for multiple labels which include float free housing labels, this includes model number, serial number, country code, UIN and name of vessel. Provision is provided on the float free housing labelling for the user to write the hyrdofix replacement date.	-
3.9 Maintenance			
	(A.702(17)/3.2) It should be recognized that, despite the use of other methods, some reliance on shore-based maintenance to ensure the availability of the functional requirements of the GMDSS will always be necessary. As defined in 3.2 g), the satellite EPIRB is a single integral unit, which is not suited for onboard repairs. As a consequence, the equipment shall be so constructed that it is readily accessible for inspection and testing purposes only, access to the interior of the satellite EPIRB shall only be possible with the use of tools.	Once the battery pack is removed access to the internal parts of the EUT can be achieved with a standard screwdriver.	-

3.13 Installation			
	The equipment manual shall contain instructions to ensure that the installed satellite EPIRB shall: a) (IV/7.1.6.2) be installed in an easily accessible position; b) (A.694(17)/2) be installed in such a manner that it is capable of meeting the requirements of this standard; c) (A.810(19)/A.2.6.1) have local manual activation; remote activation may also be provided from the navigating bridge, while the device is installed in the float-free mounting; d) (A.810(19)/A.2.6.3) release itself and float-free before reaching a water depth of 4 m at a list or trim of any angle; e) (A.662(16)/2.8) be mounted in such a way that, after being released, it is not obstructed by the structure of the sinking ship.	The Operating manual includes the following information: Mounting location (must be easily accessible) Advise to mount the EUT as high as possible to ensure an unobstructed deployment Activation details are provided (manual / float free only) no remote activation facility is provided. Refer to section 2.20 for Float Free test.	-

2.17 AUTOMATIC RELEASE MECHANISM AND AUTOMATIC ACTIVATION TEST FOR CLASS 1 AND CLASS 2 SATELLITE EPIRBS (FLOAT FREE TESTS)

2.17.1 Specification Reference

IEC 61097-2, clause A.2.2 (5.2.1 Tests for float free arrangements)

2.17.2 Equipment Under Test and Modification State

RLB-41 S/N: #8 (TUV Ref TSR0068) - Modification State 0

2.17.3 Date of Test

18 June 2015 to 23 June 2015

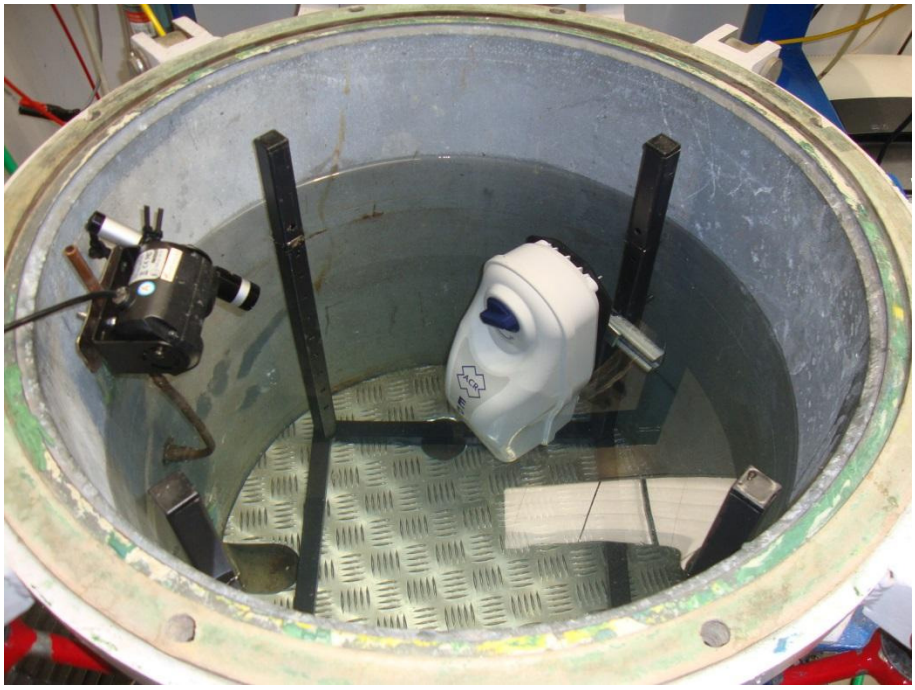
2.17.4 Test Equipment Used

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

2.17.5 Environmental Conditions

Ambient Temperature 23.9-25.4°C
Relative Humidity 38.1 – 39.6%

2.17.6 Test Setup



2.17.7 Test Method

The float free housing (with the EUT installed) was fixed to a test fixture in the normal mounting position. The test fixture was loaded into the pressure vessel and filled with water. A camera mounted inside the pressure vessel was set to monitor the release of the EPIRB from the housing.

The test was repeated with the float free housing rotated in the following orientations:

rolling 90° to starboard;
rolling 90° to port;
pitching 90° bow down;
pitching 90° stern down;
upside-down position.

The test was repeated in the normal mounting position following an 18 hour soak at 65°C.

The test was repeated in the normal mounting position following a 12 hour soak at -30°C.

2.17.8 Test Results

Orientation of Float free housing	Simulated Depth of Release (m)
normal mounting position	2.2
rolling 90° to starboard	2.2
rolling 90° to port	2.49
pitching 90° bow down	2.13
pitching 90° stern down	2.17
upside-down position	2.22
Normal mounting position (65°C)*	2.17
Normal mounting positions (-30°C)	2.17

The EPIRB was released and activated during each release. A successful self test was carried out after each release.

*Observation: following the removal from the water the EPIRB failed to switch off automatically. The EPIRB was manually switched off. The EPIRB was replaced in the water and it activated automatically and then switched off automatically on removal from the water.

2.18 STABILITY AND BUOYANCY

2.18.1 Specification Reference

IEC 61097-2, clause A.2.3

2.18.2 Equipment Under Test and Modification State

RLB-41 S/N: #7 (TUV Ref TSR0067) - Modification State 0

2.18.3 Date of Test

03 September 2015

2.18.4 Test Equipment Used

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

2.18.5 Environmental Conditions

Ambient Temperature 21.6 °C
Relative Humidity 38.2 %

2.18.6 Test Method

The EUT was floated in fresh water. The EUT was rotated to a horizontal position and released.

The distance between the antenna base and the waterline was measured.

The buoyancy was calculated by dividing the volume of the unit above the waterline by the total volume of the EUT.

2.18.7 Test Results

The EUT passed through an upright position within one second of being released.

The distance between the antenna base and the waterline exceeded 40mm.

The buoyancy was calculated by dividing the volume of the unit above the waterline by the total volume of the EUT.

EUT volume (below) waterline	= 764 mm^3
EUT volume (total)	= 992 mm^3
EUT volume above waterline (total – below)	= 228 mm^3
Buoyancy	= $\frac{228}{764}$
Reserve Buoyancy	= 0.298
	= 29.84 %

2.19 FLOAT FREE ACTIVATION (SALT WATER ACTIVATION)

2.19.1 Specification Reference

IEC 61097-2, clause A.2.4 (5.3.3.1)

2.19.2 Equipment Under Test and Modification State

RLB-41 S/N: #7 (TUV Ref TSR0067) - Modification State 0

2.19.3 Date of Test

4 September 2015

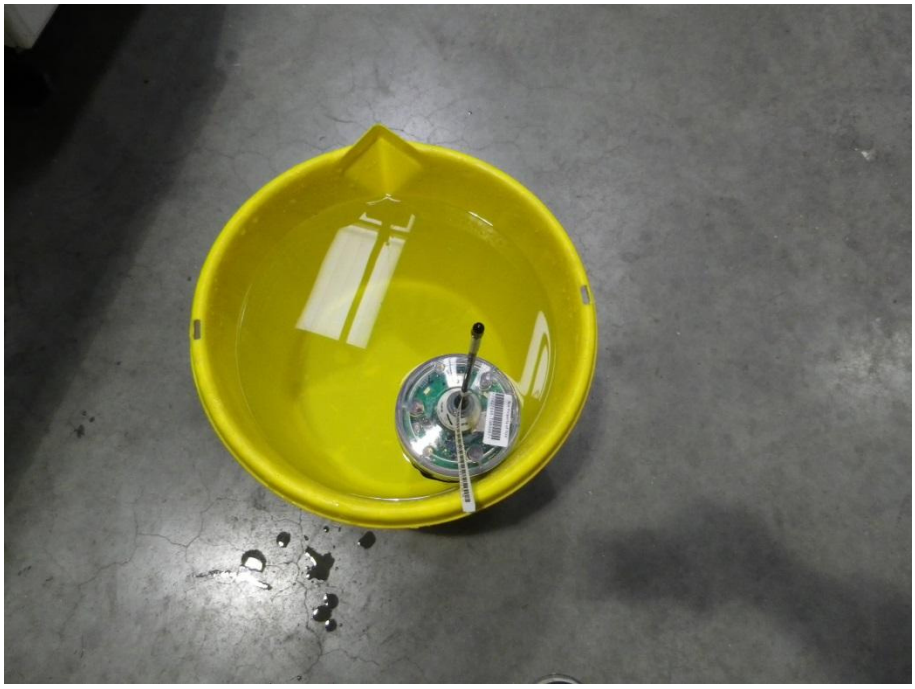
2.19.4 Test Equipment Used

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

2.19.5 Environmental Conditions

Ambient Temperature 23.7°C
Relative Humidity 39.8%

2.19.6 Test Setup



2.19.7 Test Method

The EUT was placed in a bucket of salt water (0.1%).

2.19.8 Test Results

The EUT activated within 7 seconds.

2.20 SAFETY

2.20.1 Specification Reference

IEC 61097-2, clause A.2.5

Refer to Manufacturer battery and cell data evidence – Annex B.

2.21 COMPASS SAFE DISTANCE

2.21.1 Specification Reference

IEC 61097-2, clause A.2.6

2.21.2 Equipment Under Test and Modification State

RLB-41 S/N: #26 (TUV Ref TSR051) - Modification State 0

2.21.3 Date of Test

05 March 2015

2.21.4 Test Equipment Used

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

2.21.5 Environmental Conditions

Ambient Temperature 15.5°C
Relative Humidity 39.4%

2.21.6 Test Method

A wooden table aligned E-W was used with a compass set in the centre, aligned to read zero. The table was marked to give a graduated scale of distance. The EUT was moved towards the compass until a standard deviation of 0.3° was obtained.

Each orientation of the EUT was tested in this manner with the measurement distance between the compass centre and the EUT being noted.

The test was repeated with readings taken when the compass gave a steering deviation of 0.9°.

The local area Magnetic Flux density (H) at the site of testing was 19.91uT.

The above testing was performed three times with the EUT as follows:

a. Unpowered.
b. Normalised.
c. Power applied.

Prior to performing the tests in accordance with part b above, the EUT was normalised by placing it into Helmholtz Coil Assembly and subjecting it to a magnetic field of 79A/m.

The test was applied in accordance with the test method requirements of IEC 61097-2.

The test was performed with the EUT in both idle (Standby) and active (Operating) modes.

2.21.7 Test Results

Standard Compass safe distance (mm)	600
Emergency Compass safe distance (mm)	400

Horizontal maximum flux density, Magnetic North (H)	H	19.448
Standard compass deviation limit (degrees)	5.4/H = A	A = 0.3
Emergency compass deviation limit (degrees)	18/H = B	B = 0.9

Orientation of the EUT	Un-powered State		Normalised		Powered Up	
	Distance From Compass Centre (mm) at A° deflection	Distance From Compass Centre (mm) at B° deflection	Distance From Compass Centre (mm) at A° deflection	Distance From Compass Centre (mm) at B° deflection	Distance From Compass Centre (mm) at A° deflection	Distance From Compass Centre (mm) at B° deflection
Front	370	270	430	300	420	300
Top	470 to tip of antenna	340 to tip of antenna	520 to tip of antenna	360 to tip of antenna	590 to tip of antenna	370 to tip of antenna
Left Hand Side	360	270	430	300	430	300
Right Hand Side	430	305	430	315	440	320
Underside	170, No deflection	170, No deflection	170, 0.2° deflection	170, 0.2° deflection	170, 0.2° deflection	170, 0.2° deflection
Rear	410	310	435	300	445	310

2.22 SOLAR RADIATION

2.22.1 Specification Reference

IEC 61097-2, clause A.2.7

Refer to Manufacturer waiver request - see Annex B.

2.23 OIL RESISTANCE

2.23.1 Specification Reference

IEC 61097-2, clause A.2.8

Refer to Manufacturer waiver request - see Annex B.

2.24 CORROSION

2.24.1 Specification Reference

IEC 61097-2, clause A.2.9

2.24.2 Equipment Under Test and Modification State

RLB-41 S/N: #20 (TUV Ref TSR0036) - Modification State 0

2.24.3 Date of Test

17 November to 17 December 2014

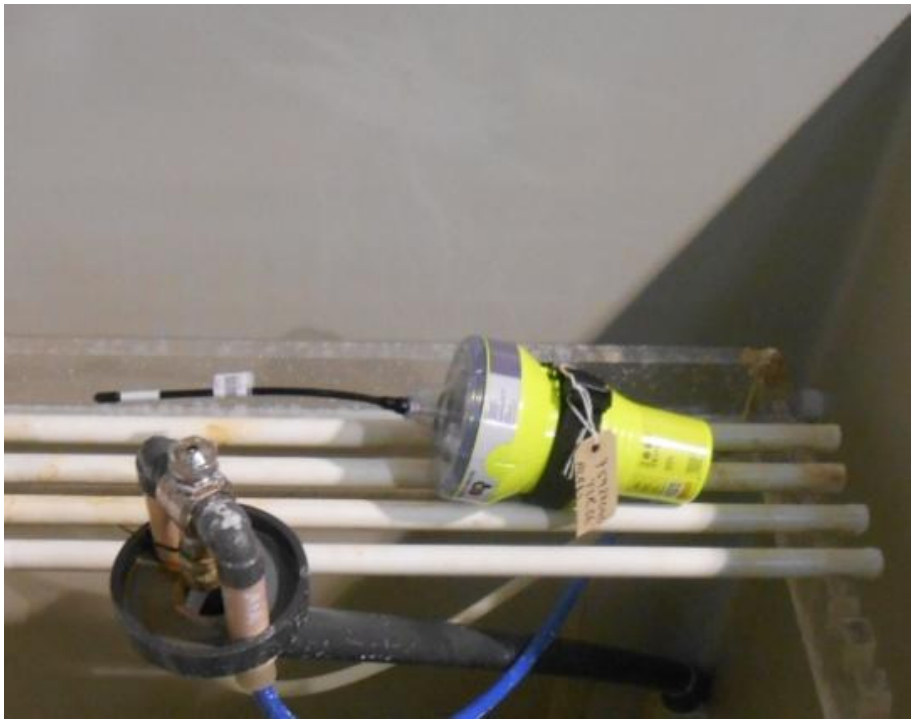
2.24.4 Test Equipment Used

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

2.24.5 Environmental Conditions

Ambient Temperature 22.2 – 23.7°C
Relative Humidity 28.8 - 45.7%

2.24.6 Test Setup



2.24.7 Test Method

The EUT was placed in a chamber and sprayed with a salt solution for 2 h at normal temperature. The salt solution was prepared by dissolving (5 ± 1) parts by weight of sodium chloride (NaCl) in 95 parts by weight of distilled or demineralised water.

At the end of the spraying period, the EUT was placed in a chamber which was maintained at a temperature of 40 °C ± 2 °C, and a relative humidity between 90 % and 95 % for a period of seven days.

The EUT was subjected to a test comprising four spraying periods, each of duration 2 h, with a storage period of seven days after each.

At the conclusion of the test the EUT was inspected with the naked eye without magnification. The EUT was then subjected to a performance check.

2.24.8 Test Results

Inspection

On completion of the test the EUT was subjected to an inspection. No sign of water ingress was found. There were signs of some corrosion around water activation contacts, as shown below:

Summary of Performance Check Results

Parameter	Result
Self-test Mode:	
Self-test Message	FFFED08C9EF9C0637FDFF83D15B7
Normal Mode:	
Normal Message 406 MHz Frequency 121 MHz Presence	FFFE2F8C9EF9C0637FDFF83D15B783E0F66C 406.039951 P

2.25 SIGNAL LIGHT

2.25.1 Specification Reference

IEC 61097-2, clause A.2.10

Refer to subcontractor (Opti Consulting Limited) report OC-0522-01.

2.26 GNSS RECEIVER

2.26.1 Specification Reference

IEC 61097-2, clause A.2.11

Refer to TUV SUD document 75928177 Report 05. The Manufacturer advises that the GNSS circuitry is identical to that in the RLB-42 model hence this report can be referenced for test data.

2.27 121.5 MHz HOMING DEVICE

2.27.1 Specification Reference

IEC 61097-2, clause A.2.12

2.27.2 Equipment Under Test and Modification State

RLB-41 S/N: #15 (TUV Ref TSR0058) - Modification State 0

2.27.3 Date of Test

12 June, 15 June 2015

2.27.4 Test Equipment Used

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

2.27.5 Environmental Conditions

Ambient Temperature 19.7 - 23.7 °C
Relative Humidity 41.5 – 58.6 %

2.27.6 Test Results

Carrier Frequency

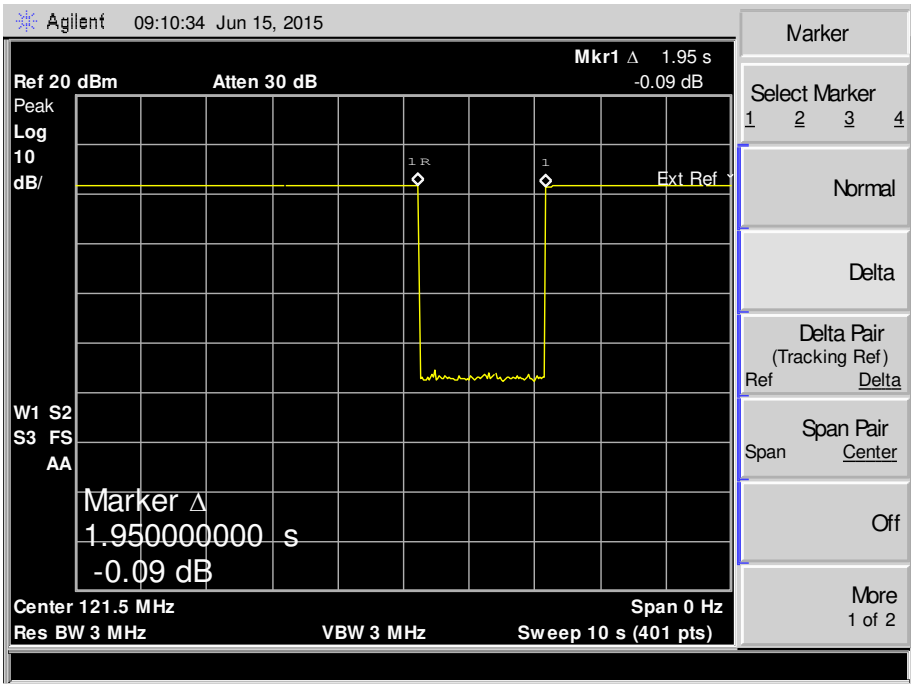
Parameter	Limit	Units	Test Results		
			T_{min} (-20 °C)	T_{amb}	T_{max} (+55 °C)
Carrier Frequency	121.5 ± 0.006075	MHz	121.499005	n/a	121.498585

Transmitter Duty Cycle

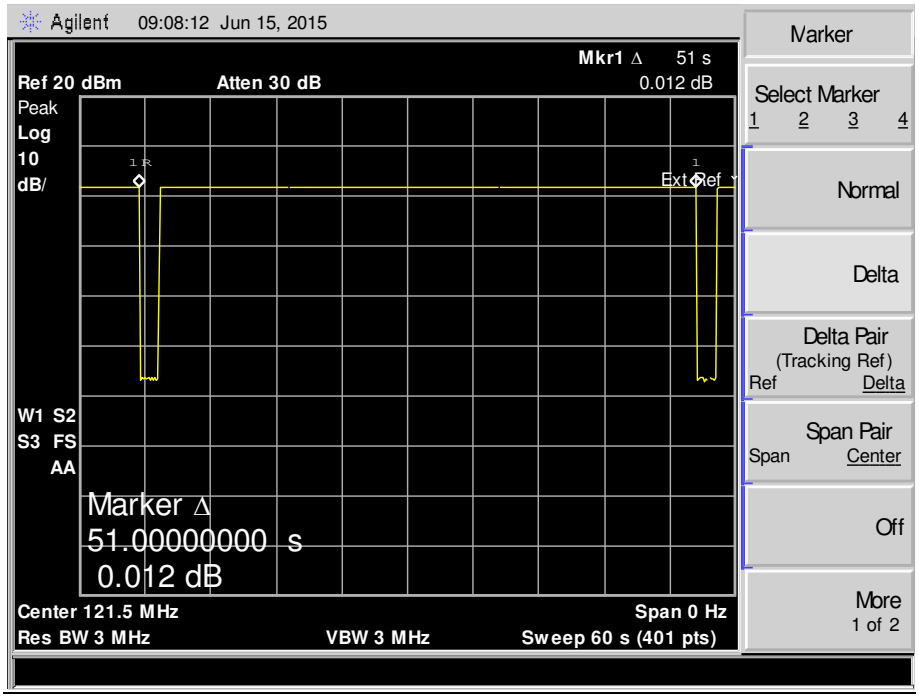
Note: Transmitter Duty Cycle = $\frac{\text{interval - duration}}{\text{interval}}$

Parameter	Units	Test Results		
		T_{min} (-20 °C)	T_{amb}	T_{max} (+55 °C)
121.5 MHz transmission interruption interval	seconds	51.00	n/a	51.75
121.5 MHz transmission interruption duration	seconds	1.95	n/a	1.925
Transmitter Duty Cycle	P/F	P	n/a	P

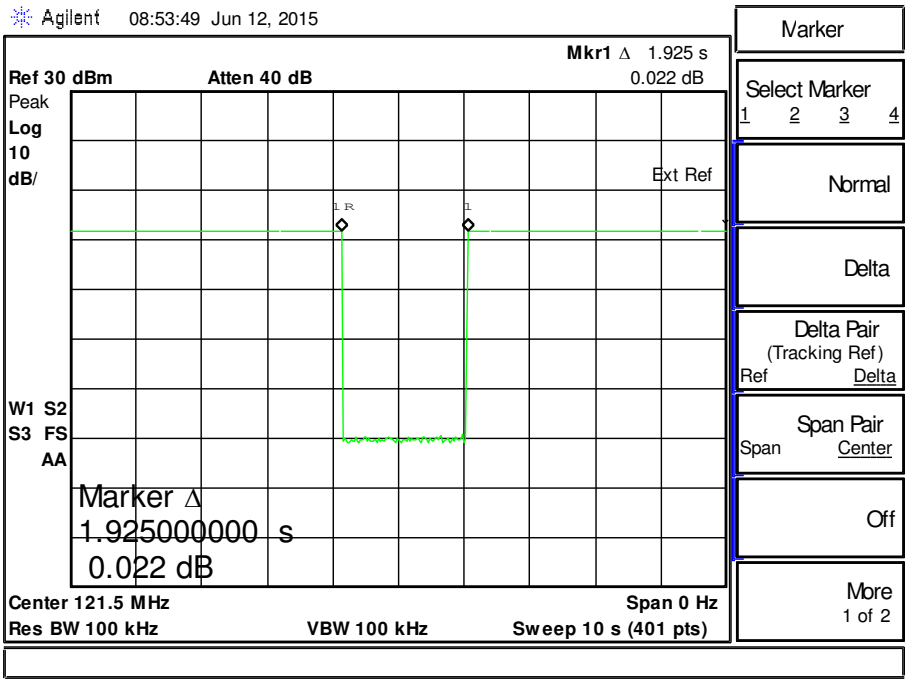
Plot showing 121.5MHz interruption duration (Minimum Temperature)



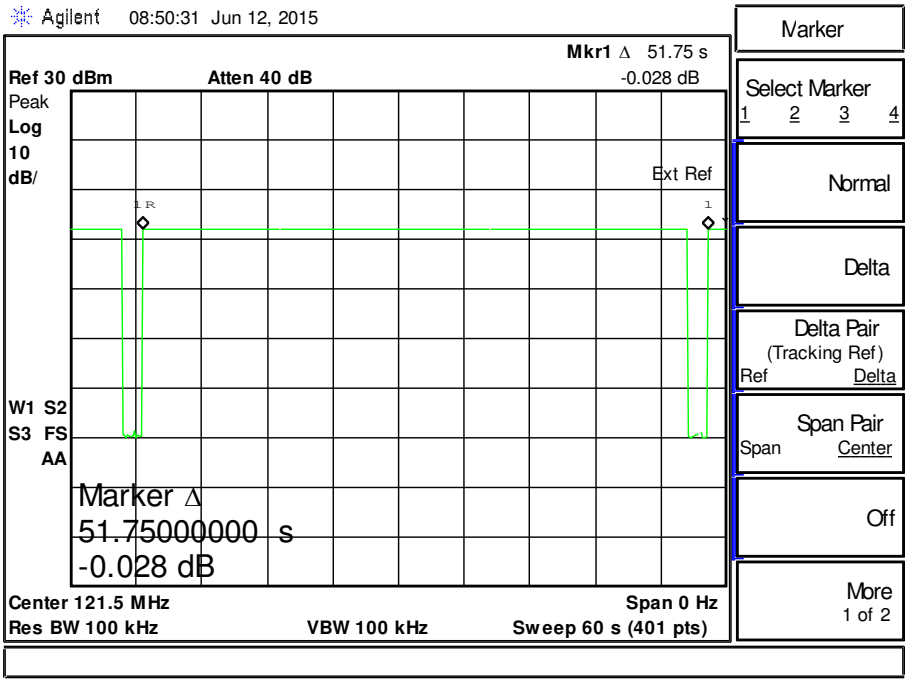
Plot showing 121.5MHz interruption interval (Minimum Temperature)



Plot showing 121.5MHz interruption duration (Maximum Temperature)



Plot showing 121.5MHz interruption interval (Maximum Temperature)



Modulation Frequency and Sweep Repetition Rate/Modulation Duty Cycle

Parameter	Units	Test Results		
		T_{min} (-20 °C)	T_{amb}	T_{max} (+55 °C)
Frequency Range	Hz	905.8	n/a	883.7
Minimum Frequency	Hz	548.7	n/a	544.9
Maximum Frequency	Hz	1454.5	n/a	1428.6
Modulation Duty Cycle*	%	37.5	n/a	38.2
Sweep repetition rate	sweeps per second	2.652	n/a	2.652

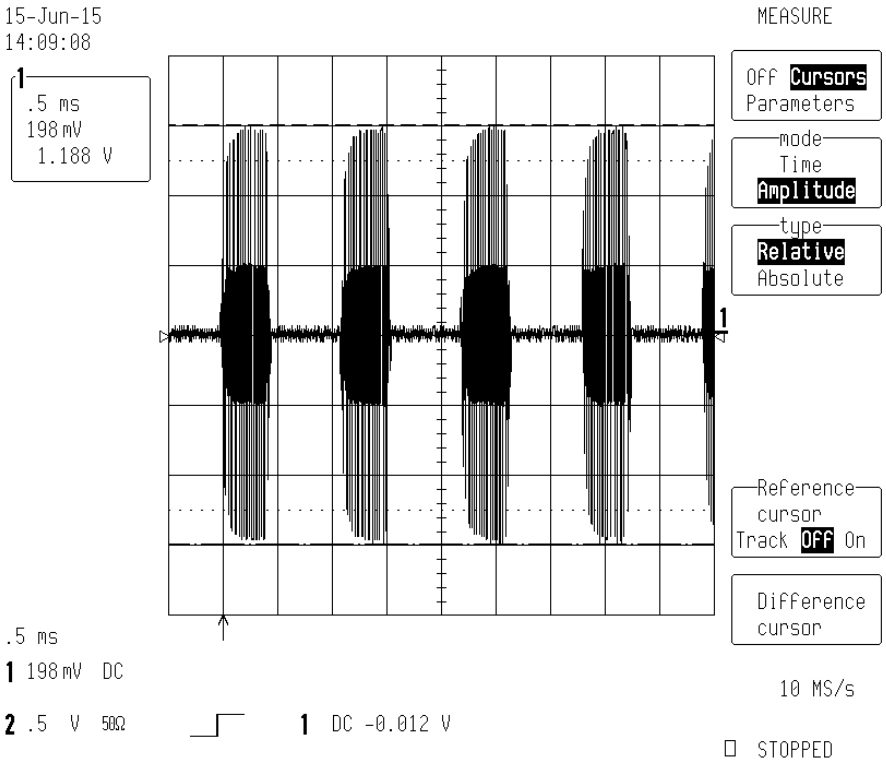
* The Modulation Duty Cycle was measured at the low, mid and upper sections of the modulation sweep. The worst case results are shown here.

Modulation Factor

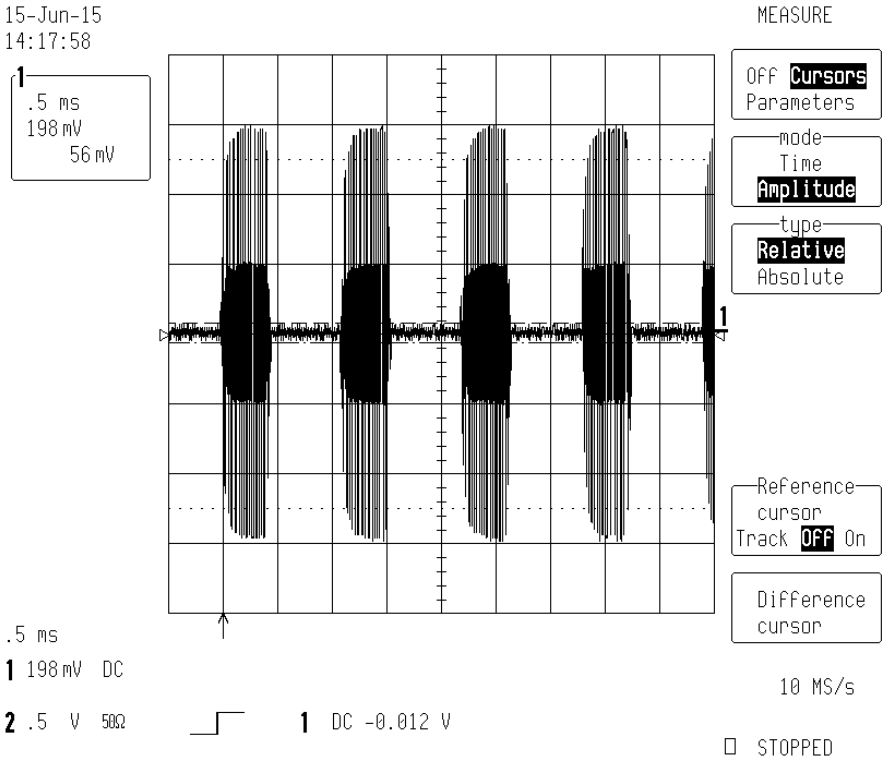
Note: Modulation Factor = (A - B) / (A + B)

Parameter	Units	Test Results		
		T_{min} (-20 °C)	T_{amb}	T_{max} (+55 °C)
A	mV	1188	n/a	1187
B	mV	56	n/a	35
Modulation Factor	(no units)	0.909	n/a	0.942

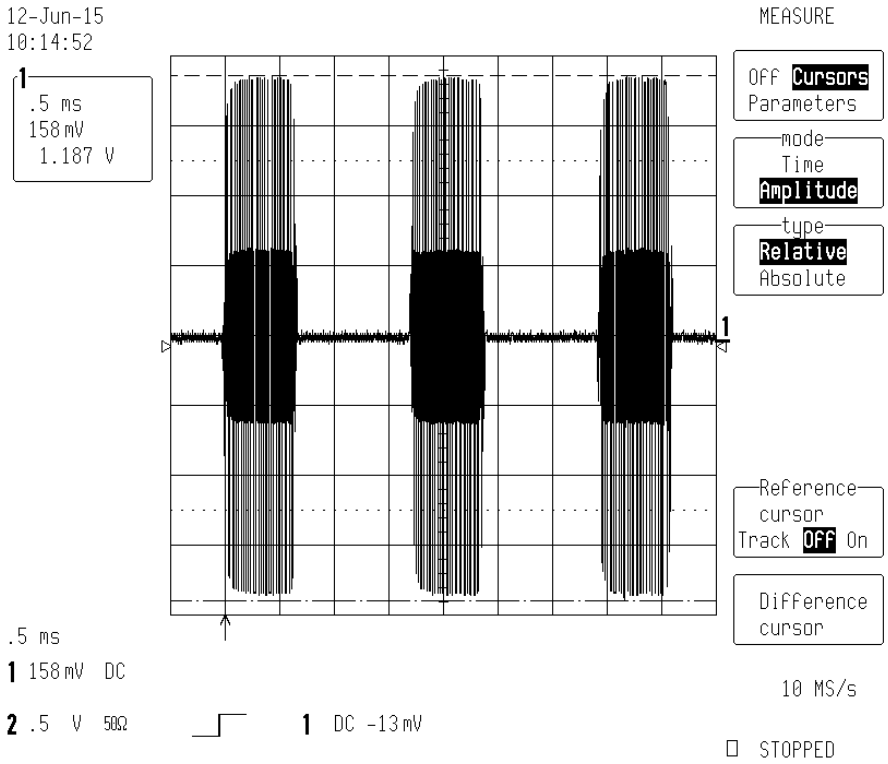
Plot showing “A” at Minimum Temperature



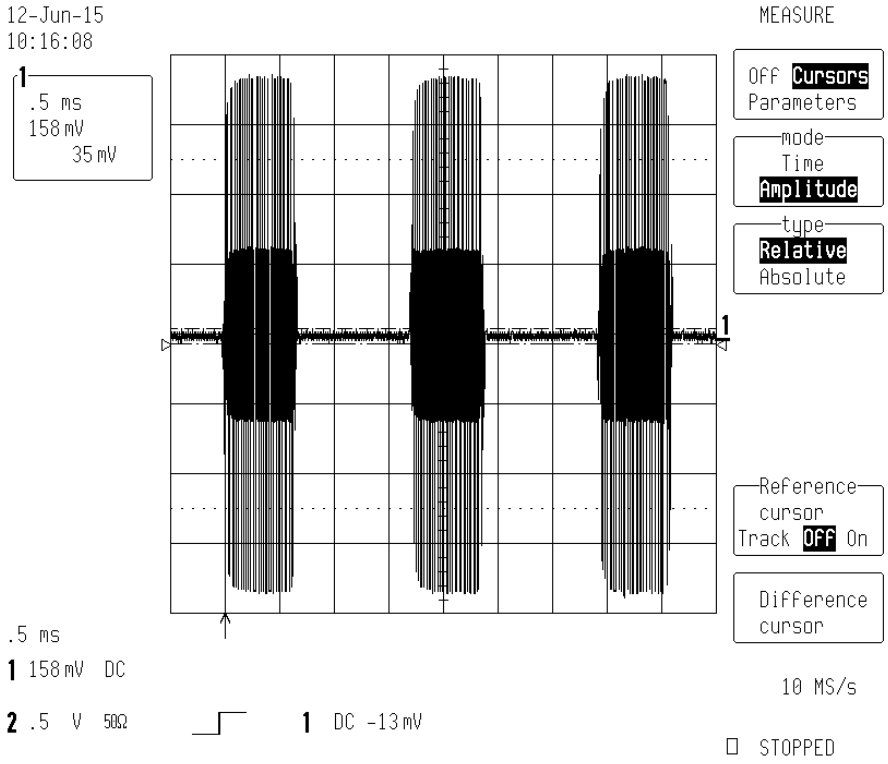
Plot Showing “B” at Minimum Temperature



Plot showing “A” Maximum Temperature



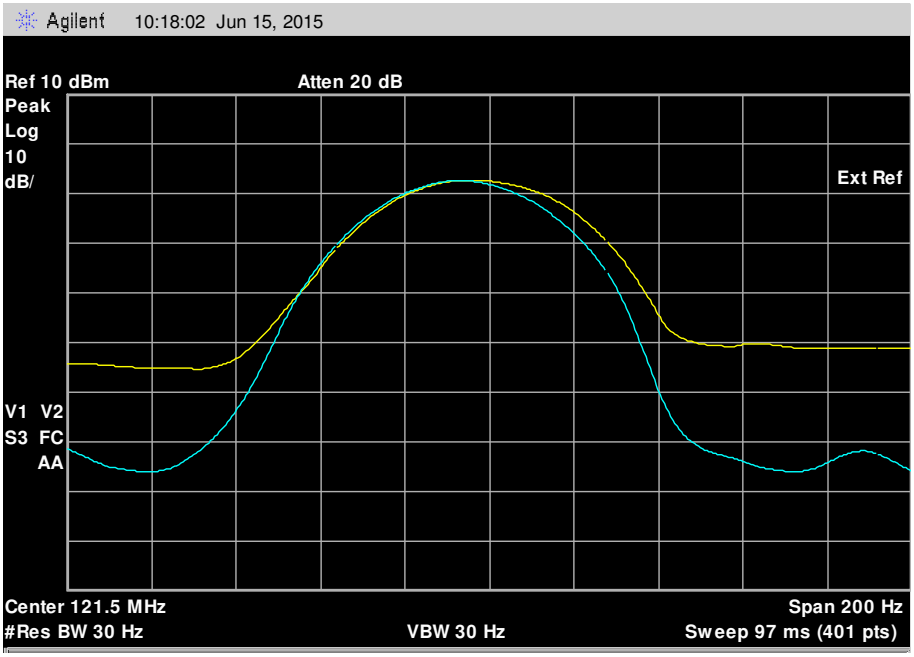
Plot Showing “B” Maximum Temperature



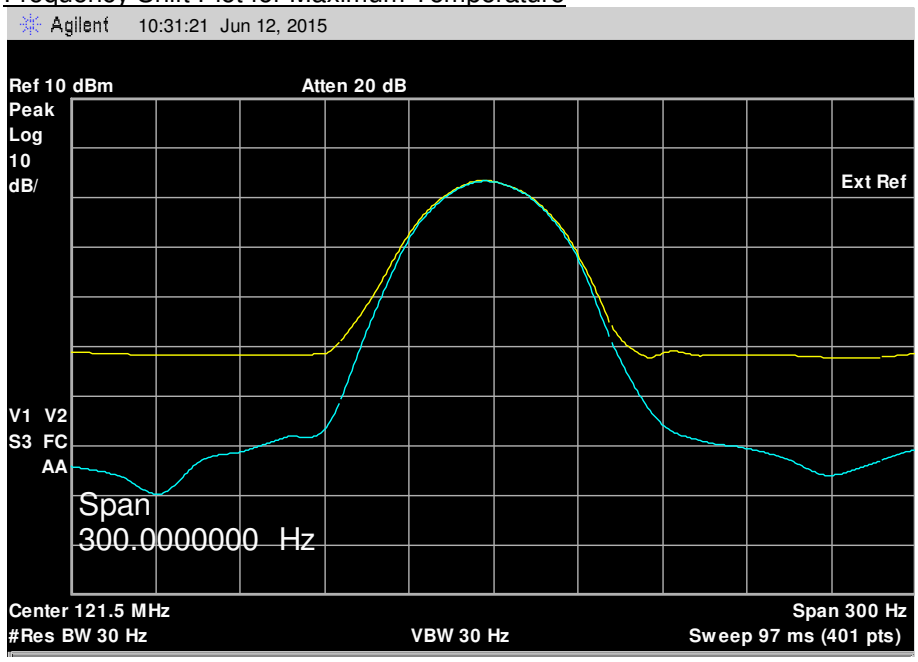
Frequency Coherence

Parameter	Units/Limit	Test Results		
		T_{min} (-20°C)	T_{amb}	T_{max} (+55°C)
30Hz Power Bandwidth	Hz/±30Hz	10.38	n/a	10.48
Frequency Shift	Hz	1	n/a	1

Frequency Shift Plot for Minimum Temperature



Frequency Shift Plot for Maximum Temperature



Peak Equivalent Isotropic Radiated Power

Refer to subcontractor (Hursley EMC Services) report 15R146 ER.

2.28 TEST TO PREVENT RELEASE WHEN WATER WASHES OVER THE UNIT (HOSE STREAM) (NUA)

2.28.1 Specification Reference

IEC 61097-2, clause A.2.1 (5.5.1.1)

2.28.2 Equipment Under Test and Modification State

RLB-41 S/N: #9 (TUV Ref TSR0064) - Modification State 0

2.28.3 Date of Test

9 September 2015

2.28.4 Test Equipment Used

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

2.28.5 Test Setup

Setup Photo (manual bracket and float free housing)

2.28.6 Test Method

The EUT was fixed via the supplied manual mounting bracket and float free housing and fixed to a test rig ready for the water test. The water spray (measured at approximately 2400l / min) was directed at 5 faces of the EUT for 1 min in each face. The five faces were:

Face on
45 degrees to the left
45 degree to the right
90 degrees to the left
90 degree to the right

2.28.7 Test Results

Manual Housing

Face on: During test the security tab securing the button cover on the RLB-41 beacon was sheared enabling the gate to move right exposing the activation button. However no activation of the beacon was visible post test and the beacon remained within the mounting bracket throughout.

45 degree left and 90 degree left: Button cover pushed right by water stream but no activation of the beacon visible. Beacon remained securely in the mounting bracket.

45 degree right and 90 degree right: Button cover remained over the activation button with no activation of the beacon visible. Beacon remained securely in its mounting bracket throughout.

Float free Housing

Face on: No visible damage to enclosure which remained closed throughout test. No visual activation of beacon. EPIRB label washed off during test.

45 degree left, right and 90 degree left and right: No visible damage to enclosure which remained closed throughout test. No visual activation of beacon.

SECTION 3

TEST EQUIPMENT

3.1 TEST EQUIPMENT

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

Instrument	Manufacturer	Type No.	TE No.	Calibration Period (months)	Calibration Due
Section 2.1 Beacons - Initial Aliveness Test					
Power Meter	Hewlett Packard	436A	83	12	29-Aug-2015
Signal Generator	Hewlett Packard	8644A	96	12	23-Apr-2015
RF Shielded Enclosure	Rittal	AE1380	162	-	TU
Termination (50ohm)	Diamond Antenna	DL-30N	226	12	6-Feb-2016
Termination (50ohm)	Diamond Antenna	DL-30N	337	12	8-Oct-2015
Distress Beacon RF Unit	TUV SUD Product Service	-	2445	-	TU
Stop Clock	R.S Components	RS328 061	2674	12	30-Jun-2015
Hygromer	Rotronic	I-1000	2829	12	27-Oct-2015
Termination (50ohm, 6W)	Microndе	R404613	3074	12	27-Mar-2016
Attenuator (20dB, 10W)	Aeroflex / Weinschel	23-20-34	3159	12	4-Jun-2015
Attenuator (20dB, 10W)	Aeroflex / Weinschel	23-20-34	3160	12	4-Jun-2015
Attenuator (3dB, 20W)	Aeroflex / Weinschel	23-03-34	3163	12	16-Sep-2015
Bandpass Filter	Trilithic	5BE406/35-1-AA	3205	12	17-Sep-2015
Time Interval Analyser	Yokogawa	TA720 704510	3253	12	11-Nov-2015
ScopeCorder	Yokogawa	DL750 701210	3254	12	10-Nov-2015
Beacon Tester	WS Technologies	BT100S	3263	-	TU
RF Short Circuit	TUV SUD Product Service	Short Circuit	3268	-	TU
Short Circuit	TUV SUD Product Service	Short Cicuit	3272	-	TU
Power Sensor	Agilent Technologies	8482A	3290	12	16-Jan-2016
ESA-E Series Spectrum Analyser	Agilent Technologies	E4402B	3348	12	5-Sep-2015
Cable (1m, N Type)	Rhophase	NPS-1601-1000-NPS	3352	12	29-Apr-2015
Cable (2m, N Type)	Rhophase	NPS-1601-2000-NPS	3357	12	29-Apr-2015

Instrument	Manufacturer	Type No.	TE No.	Calibration Period (months)	Calibration Due
Section 2.2 Climatic - High Temperature (Functional)					
Power Meter	Hewlett Packard	436A	83	12	29-Aug-2015
Signal Generator	Hewlett Packard	8644A	96	12	23-Apr-2015
Termination (50ohm)	Diamond Antenna	DL-30N	337	12	8-Oct-2015
Attenuator (10dB, 10W)	Texscan	HFP-50N	468	12	23-Jun-2015
Signal Generator	Hewlett Packard	8663A	765	12	4-Nov-2015
Attenuator (10dB, 10W)	Trilithic	HFP-50N	1377	12	22-Oct-2015
Chamber	Heraeus	HC 4033	2174	12	20-May-2015
Distress Beacon RF Unit	TUV SUD Product Service	-	2445	-	TU
Climatic Chamber	Climatec	CLIMATEC 3	2846	12	2-Jun-2015
Termination (50ohm, 15W)	Diamond Antenna	DL-30N	3096	12	4-Mar-2016
Attenuator (20dB, 10W)	Aeroflex / Weinschel	23-20-34	3159	12	4-Jun-2015
Attenuator (3dB, 20W)	Aeroflex / Weinschel	23-03-34	3162	12	18-Nov-2015
Bandpass Filter	Trilithic	5BE406/35-1-AA	3205	12	17-Sep-2015
Time Interval Analyser	Yokogawa	TA720 704510	3253	12	11-Nov-2015
ScopeCorder	Yokogawa	DL750 701210	3254	12	10-Nov-2015
Beacon Tester	WS Technologies	BT100S	3263	-	TU
RF Short Circuit	TUV SUD Product Service	Short Circuit	3268	-	TU
Short Circuit	TUV SUD Product Service	Short Cicuit	3272	-	TU
Power Sensor	Agilent Technologies	8482A	3290	12	16-Jan-2016
ESA-E Series Spectrum Analyser	Agilent Technologies	E4402B	3348	12	5-Sep-2015
Cable (2m, N Type)	Rhophase	NPS-1601-2000-NPS	3355	12	3-Dec-2015
Cable (3m, N-type)	Rhophase	NPS-1601-3000-NPS	3361	12	24-Jul-2015
2 metre SMA Cable	Florida Labs	SMS-235SP-78.8-SMS	4517	12	29-Jan-2016
Section 2.3 Climatic - Humidity					
Climatic Chamber	Climatec	CLIMATEC 3	2846	12	1-Jun-2016
Beacon Tester	WS Technologies	BT100S	3263	-	TU
ESA-E Series Spectrum Analyser	Agilent Technologies	E4402B	3348	12	5-Sep-2015
Cable (2m, N Type)	Rhophase	NPS-1601-2000-NPS	3355	12	3-Dec-2015

Section 2.4 Vibration - Sine					
Beacon Tester	WS Technologies	BT 100S	87	-	TU
Charge Amplifier	Endevco	133	2499	12	2-Dec-2015
Charge Amplifier	Endevco	133	2506	12	28-Nov-2015
Vibration System	Ling Dynamic Systems	LDS V964	2515	6	2-Dec-2015
Isotron Accelerometer	Endevco	256-10	3112	-	17-Jun-2015
Isotron Accelerometer	Endevco	256-10	3113	6	9-Jan-2016
Vibration System	Ling Dynamic Systems	875	3170	6	30-Sep-2015
Charge Amplifier	Endevco	133	3189	12	20-Jul-2016
Beacon Tester	WS Technologies	BT100S	3263	-	TU
ESA-E Series Spectrum Analyser	Agilent Technologies	E4402B	3348	12	5-Sep-2015
Cable (3m, N-type)	Rhophase	NPS-1601-3000-NPS	3361	12	24-Jul-2015
Vibration Controller	m + p International	Vibpilot 8	3768	12	13-May-2016
Vibration Controller	m + p International	Vibpilot 8	3769	12	12-May-2016
Vibration Controller (8 Ch)	m + p International	VibPilot 8	3777	12	23-Jun-2016
Isotron Accelerometer	Endevco	256-10	3806	6	9-Jul-2015
Accelerometer	Endevco	256-10	3987	6	28-Oct-2015
Accelerometer	Meggitt	256-10	4222	6	9-Jan-2016
Accelerometer	Meggitt Endevco	256-10	4272	6	15-Nov-2015
Accelerometer	Meggitt Endevco	256-10	4306	6	26-Apr-2016
Accelerometer	PCB Piezotronic	352C03	4338	6	1-Jan-2016
Accelerometer	PCB Piezotronic	352C03	4475	6	1-Jan-2016
Isotron Accelerometer	PCB Piezotronic	M353B18	4568	12	26-May-2016
Section 2.4 Vibration - Sine on Random					
Accelerometer	Endevco	7254A-10	2537	6	14-Jan-2016
Accelerometer	Endevco	7254-A-10	2543	6	15-Jan-2016
Vibration System	Ling Dynamic Systems	875	3170	6	30-Sep-2015
Charge Amplifier	Endevco	133	3189	12	20-Jul-2016
Charge Amplifier	Endevco	133	3192	12	1-Dec-2015
Vibration Controller (8 Ch)	m + p International	VibPilot 8	3779	12	13-Jul-2016
Accelerometer	Meggitt Endevco	256-10	4306	6	26-Apr-2016
Section 2.5 Ruggedness					
Beacon Tester	WS Technologies	BT 100S	87	-	TU
Charge Amplifier	Endevco	133	2499	12	2-Dec-2015
Charge Amp	Endevco	133	2500	12	27-Nov-2015
Vibration System	Ling Dynamic Systems	LDS V964	2515	6	12-Jun-2015
Isotron Accelerometer	Endevco	256-10	3112	-	17-Jun-2015
Attenuator (20dB, 10W)	Aeroflex / Weinschel	23-20-34	3158	12	30-Jun-2015
Beacon Tester	WS Technologies	BT100S	3263	-	TU
ESA-E Series Spectrum Analyser	Agilent Technologies	E4402B	3348	12	5-Sep-2015
Vibration Controller	m + p International	Vibpilot 8	3768	12	12-May-2015
Accelerometer	Endevco	256-10	3992	6	8-May-2015
Accelerometer	PCB Piezotronic	352C03	4337	6	8-May-2015
Section 2.7 Beacons - 60945 Drop Into Water					
Beacon Tester	WS Technologies	BT100S	3263	-	TU
Humidity & Temperature Meter	Radio Spares	1361C	4420	12	1-May-2015
Section 2.8 Climatic - Thermal Shock					
Beacon Tester	WS Technologies	BT 100S	87	-	TU
Climatic Chamber	Fisons	Fisons 5	2123	12	10-Dec-2015
Balance	Geniweigher	GM-11K	2334	12	12-Mar-2016
Climatic Chamber	Climatec	CLIMATEC 3	2846	12	2-Jun-2015
ESA-E Series Spectrum Analyser	Agilent Technologies	E4402B	3348	12	5-Sep-2015
Instrument	Manufacturer	Type No.	TE No.	Calibration Period (months)	Calibration Due

Section 2.9 Climatic - Immersion					
Over Pressure (T)	ASL (TUV)	0 TO 15 PSI	2125	-	TU
Pressure Indicator	Druck	DPI 700	2343	12	23-Dec-2015
Section 2.10 and 2.13 Beacons - Spurious Emissions					
Climatic Chamber	Heraeus Votsch	VM 04/100	85	-	O/P Mon
Rubidium Frequency Standard	Quartzlock	A10-B	92	12	11-Feb-2016
Attenuator (10dB, 10W)	Texscan	HFP-50N	468	12	23-Jun-2015
3dB/10W Attenuator	Texscan	HFP-50N	475	12	1-Apr-2016
Attenuator (10dB, 10W)	Trilithic	HFP-50N	1377	12	22-Oct-2015
Hygromer	Rotronic	I-1000	2829	12	27-Oct-2015
Attenuator (20dB, 10W)	Aeroflex / Weinschel	23-20-34	3158	12	30-Jun-2015
Attenuator (20dB, 10W)	Aeroflex / Weinschel	23-20-34	3160	12	9-Jun-2016
Attenuator (3dB, 20W)	Aeroflex / Weinschel	23-03-34	3163	12	16-Sep-2015
Thermocouple Thermometer	Fluke	51	3172	12	24-Sep-2015
Bandpass Filter	Trilithic	5BE406/35-1-AA	3207	12	17-Sep-2015
ESA-E Series Spectrum Analyser	Agilent Technologies	E4402B	3348	12	5-Sep-2015
Rubidium Frequency Standard	Symmetricom	8040C	3490	12	8-Apr-2016
1 metre SMA Cable	Florida Labs	SMS-235SP-39.4-SMS	4512	12	29-Jan-2016
1 metre SMA Cable	Florida Labs	SMS-235SP-39.4-SMS	4513	12	29-Jan-2016

Instrument	Manufacturer	Type No.	TE No.	Calibration Period (months)	Calibration Due
Section 2.12 Beacons - Constant Temperature Tests					
Power Meter	Hewlett Packard	436A	47	12	11-Jul-2015
Power Meter	Hewlett Packard	436A	83	12	29-Aug-2015
Climatic Chamber	Heraeus Votsch	VM 04/100	85	-	O/P Mon
Rubidium Frequency Standard	Quartzlock	A10-B	92	12	11-Feb-2016
Time Interval Analyser	Yokogawa	TA720	181	12	24-Apr-2016
Termination (50ohm)	Diamond Antenna	DL-30N	226	12	6-Feb-2016
Termination (50ohm)	Diamond Antenna	DL-30N	337	12	8-Oct-2015
Attenuator (10dB, 10W)	Texscan	HFP-50N	468	12	23-Jun-2015
3dB/10W Attenuator	Texscan	HFP-50N	475	12	1-Apr-2016
Signal Generator (100kHz to 2.6GHz)	Hewlett Packard	8663A	1063	12	9-Apr-2016
Spectrum Analyser	Agilent Technologies	E4407B	1154	12	21-Aug-2015
Attenuator (10dB, 10W)	Trilithic	HFP-50N	1377	12	22-Oct-2015
Stop Clock	R.S Components	RS328 061	2674	12	30-Jun-2015
Hygromer	Rotronic	I-1000	2829	12	27-Oct-2015
GPS/SBAS Simulator	Spirent	STR4500	3056	-	TU
Beacon RF Unit	TUV SUD Product Service	N/A	3066	-	TU
Termination (50ohm, 0.5W)	Hewlett Packard	HP11593A	3086	-	TU
Termination (50ohm, 15W)	Diamond Antenna	DL-30N	3096	12	4-Mar-2016
Termination (50ohm, 15W)	Diamond Antenna	DL-30N	3098	12	27-Mar-2016
Attenuator (20dB, 10W)	Aeroflex / Weinschel	23-20-34	3158	12	30-Jun-2015
Attenuator (20dB, 10W)	Aeroflex / Weinschel	23-20-34	3159	12	3-Jun-2016
Attenuator (20dB, 10W)	Aeroflex / Weinschel	23-20-34	3160	12	9-Jun-2016
Attenuator (3dB, 20W)	Aeroflex / Weinschel	23-03-34	3162	12	18-Nov-2015
Attenuator (3dB, 20W)	Aeroflex / Weinschel	23-03-34	3163	12	16-Sep-2015
Thermocouple Thermometer	Fluke	51	3172	12	24-Sep-2015
Bandpass Filter	Trilithic	5BE406/35-1-AA	3207	12	17-Sep-2015
RF Short Circuit	TUV SUD Product Service	Short Circuit	3268	-	TU
Power Sensor	Agilent Technologies	8482A	3289	12	16-Jan-2016
Power Sensor	Agilent Technologies	8482A	3290	12	16-Jan-2016
ESA-E Series Spectrum Analyser	Agilent Technologies	E4402B	3348	12	5-Sep-2015
Cable (1m, N Type)	Rhophase	NPS-1601-1000-NPS	3351	12	30-Apr-2016
Cable (1m, N Type)	Rhophase	NPS-1601-1000-NPS	3352	12	30-Apr-2016
Cable (2m, N Type)	Rhophase	NPS-1601-2000-NPS	3358	12	3-Dec-2014
Cable (3m, N-type)	Rhophase	NPS-1601-3000-NPS	3361	12	24-Jul-2015
ScopeCorder	Yokogawa	DL750	4175	12	28-Jan-2016
GPS Antenna	SRT Marine Technology Ltd	260-0002	4225	-	TU
1 metre N-Type Cable	Florida Labs	NMS-235SP-39.4-NMS	4509	12	20-May-2016
1 metre SMA Cable	Florida Labs	SMS-235SP-39.4-SMS	4512	12	29-Jan-2016
1 metre SMA Cable	Florida Labs	SMS-235SP-39.4-SMS	4513	12	29-Jan-2016

Instrument	Manufacturer	Type No.	TE No.	Calibration Period (months)	Calibration Due
Section 2.13 EMC - Radiated Immunity					
Signal Generator 10kHz to 2.7GHz	Marconi	2031	19	12	16-Mar-2016
Antenna (Bilog)	Schaffner	CBL6143	316	-	TU
Power Meter	Rohde & Schwarz	NRVD	747	-	TU
Spectrum Analyser	Hewlett Packard	8591A	771	12	22-Jul-2015
Screened Room (1)	Rainford	Rainford	1541	-	TU
Amplifier (1kW)	EMV	1000W1000M7	1633	-	TU
Laser Powered Electric Field Sensor	Dare Development	RadiSense VI - CTR1001A	2148	12	17-Jul-2015
Directional Coupler	Amp Research	DC6180	2763	-	TU
Beacon Tester	WS Technologies	BT100S	3263	-	TU
Microwave Amplifier 1GHz - 2.5GHz; 500W; CW	Thorn	PTC6440	3736	-	TU
Power Sensor; 100kHz - 6GHz/500pW - 20mW	Rohde & Schwarz	NRV-Z4	3815	-	TU
Section 2.14 EMC - Electrostatic Discharges					
Multimeter	Iso-tech	IDM101	2418	12	26-Sep-2015
ESD Gun	Schloder	SESD 30000	4319	12	13-Oct-2015
Section 2.17 Climatic - Wet Tests					
Beacon Tester	WS Technologies	BT 100S	87	-	TU
Over Pressure (T)	ASL (TUV)	0 TO 15 PSI	2125	-	TU
Balance	Geniweigher	GM-11K	2334	12	12-Mar-2016
Pressure Indicator	Druck	DPI 700	2343	12	23-Dec-2015
ESA-E Series Spectrum Analyser	Agilent Technologies	E4402B	3348	12	5-Sep-2015
Stopwatch	R.S Components	309RS	4553	12	18-Mar-2016
Section 2.21 EMC - Compass Safe Distance					
Sussex Helmholtz Coil	Various	88771	327	-	TU
Magnetometer	Bartington	MAG01	671	36	24-Feb-2018
Multimeter	Iso-tech	IDM101	2422	12	22-Jan-2016
Compass Verification Unit	TUV SUD Product Service	CVU	3579	-	TU
Marine Binnacle Compass with Repeater Display	Cassens & Plath	Compass: Type 11	3834	-	TU
Section 2.24 Climatic - Corrosion					
Beacon Tester	WS Technologies	BT 100S	87	-	TU
Spectrum Analyser	Agilent Technologies	E4407B	1154	12	21-Aug-2015
Section 2.27 Beacons - 121 Emission Characteristics					
Climatic Chamber	Heraeus Votsch	VM 04/100	85	-	O/P Mon
Rubidium Frequency Standard	Quartzlock	A10-B	92	12	11-Feb-2016
1GHz Digital Oscilloscope	Lecroy	9370M	612	12	23-Oct-2015
Hygromer	Rotronic	I-1000	2829	12	27-Oct-2015
Attenuator (20dB, 10W)	Aeroflex / Weinschel	23-20-34	3159	12	3-Jun-2016
Thermocouple Thermometer	Fluke	51	3172	12	24-Sep-2015
ESA-E Series Spectrum Analyser	Agilent Technologies	E4402B	3348	12	5-Sep-2015
1 metre N-Type Cable	Florida Labs	NMS-235SP-39.4-NMS	4509	12	20-May-2016
Section 2.27 Beacons - 121 Modulation Characteristics					
Test Receiver	Rohde & Schwarz	ESIB26	2085	0	4-Mar-2016
Oscilloscope	Lecroy	9370	2832	12	24-Oct-2015
Section 2.28 TUV NEL - Hose Stream					
Ultrasonic Flowmeter	Flexim	CDQ1N27	NEL 15401	-	TU

TU – Traceability Unscheduled
O/P MON – Output Monitored with Calibrated Equipment

SECTION 4

PHOTOGRAPHS

4.1 PHOTOGRAPHS OF EQUIPMENT UNDER TEST (EUT)

Radiated sample

Conducted Sample

Float Free Housing View 1

Float Free Housing View 2

Manual Bracket 1

SECTION 5

ACCREDITATION, DISCLAIMERS AND COPYRIGHT

5.1 ACCREDITATION, DISCLAIMERS AND COPYRIGHT

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

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

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

ANNEX A

LIMITED C/S TESTING (SUMMARY OF RESULTS)

Product Service

TEST RESULTS TABLE

Parameters to be Measured		Range of Specification	Units	Test Results			Comments
				Tmin	Tamb	Tmax	
				(-20°C)	(+21°C)	(+55°C)	
1. Power Output							**Result: Pass**
Model: RLB-41, S/N: #15, TUV Ref: TSR0058 and Modification State 0							
Transmitter power output	(maximum)	35 - 39	dBm	-	38.88	-	
	(minimum)			-	38.87	-	
Power output rise time	(maximum)	< 5	ms	-	0.29	-	
	(minimum)			-	0.28	-	
Power output 1ms before burst	(maximum)	< -10	dBm	-	-35.90	-	
	(minimum)			-	-39.86	-	
2. Digital Message Coding							**Result: Pass**
Model: RLB-41, S/N: #15, TUV Ref: TSR0058 and Modification State 0							
Bit Sync	1 - 15	15 bits “1”	P / F	-	P	-	
Frame sync	16 - 24	“000101111”	P / F	-	P	-	
Format flag	25	1 bit	bit value	-	1	-	
Protocol flag	26	1 bit	bit value	-	0	-	
Identification / position data	27 - 85	59 bits	P / F	-	P	-	
BCH code	86 -106	21 bits	P / F	-	P	-	
Emerg. Code/nat. use/supplem. Data	107 - 112	6 bits	bit value	-	110111	-	
Additional data / BCH (if applicable)	112 - 144	32 bits	P / F	-	P	-	
Position Error (if applicable)		< 5	km	-	n/a	-	

Parameters to be Measured		Range of Specification	Units	Test Results			Comments
				Tmin	Tamb	Tmax	
				(-20°C)	(+21°C)	(+55°C)	
3. Digital Message Generator							**Result: Pass**
Model: RLB-41, S/N: #15, TUV Ref: TSR0058 and Modification State 0							
Repetition rate, T_R:							
Average T_R		48.5 ≤ T_{Ravg} ≤ 51.5	seconds	-	50.018	-	
Minimum T_R		47.5 ≤ T_{Rmin} ≤ 48.0	seconds	-	47.845	-	
Maximum T_R		52.0 ≤ T_{Rmax} ≤ 52.5	seconds	-	52.401	-	
Standard deviation		0.5 - 2.0	seconds	-	1.34	-	
Bit rate							
Minimum fb		≥ 396	bits/sec	-	399.91	-	
Maximum fb		≤ 404	bits/sec	-	399.93	-	
Total transmission time							
Short message	(maximum)	435.6 - 444.4	ms	-	n/a	-	
	(minimum)			-	n/a	-	
Long message	(maximum)	514.8 - 525.2	ms	-	520.04	-	
	(minimum)			-	519.99	-	
Unmodulated carrier							
Minimum T1		≥ 158.4	ms	-	159.98	-	
Maximum T1		≤ 161.6	ms	-	160.04	-	
First burst delay		≥ 47.5	seconds	-	50	-	

Parameters to be Measured		Range of Specification	Units	Test Results			Comments
				Tmin	Tamb	Tmax	
				(-20°C)	(+21°C)	(+55°C)	
4. Modulation							**Result: Pass**
Model: RLB-41, S/N: #15, TUV Ref: TSR0058 and Modification State 0							
Biphase-L		P / F	P / F	-	P	-	
Rise time	(maximum)	50 - 250	µs	-	194.4	-	
	(minimum)	50 - 250	µs	-	171.3	-	
Fall time	(maximum)	50 - 250	µs	-	188.7	-	
	(minimum)	50 - 250	µs	-	167.6	-	
Phase deviation: positive	(maximum)	+(1.0 to 1.2)	radians	-	1.1911	-	
	(minimum)	+(1.0 to 1.2)	radians	-	1.0182	-	
Phase deviation: negative	(maximum)	-(1.0 to 1.2)	radians	-	-1.1913	-	
	(minimum)	-(1.0 to 1.2)	radians	-	-1.0276	-	
Symmetry measurement		≤ 0.05		-	0.0202	-	
5. 406 MHz Transmitted Frequency							**Result: Pass**
Model: RLB-41, S/N: #15, TUV Ref: TSR0058 and Modification State 0							
Nominal Value	(maximum)	C/S T.001	MHz	-	406.0399677	-	
	(minimum)			-	406.0399675	-	
Short-term stability	(maximum)	≤ $2x10^{-9}$	/100ms	-	13.541E-11	-	
	(minimum)			-	94.438E-12	-	
Medium-term stability – Slope	(maximum)	(-1 to +1)$x10^{-9}$	/minutes	-	90.061E-12	-	
	(minimum)			-	-11.172E-11	-	
Medium-term stability – Residual frequency variation	(maximum)	≤ $3x10^{-9}$		-	35.185E-11	-	
	(minimum)			-	15.974E-11	-	
6. Spurious Emissions into 50ohms							**Result: Pass**
Model: RLB-41, S/N: #15, TUV Ref: TSR0058 and Modification State 0							
In band (406.0 – 406.1 MHz)		C/S T.001 mask	P / F	P			

Parameters to be Measured		Range of Specification	Units	Test Results			Comments
				Tmin	Tamb	Tmax	
				(-20°C)	(+21°C)	(+55°C)	
7. 406 MHz VSWR Check							**Result: Pass**
Model: RLB-41, S/N: #15, TUV Ref: TSR0058 and Modification State 0							
Nominal transmitted frequency		C/S T.001	MHz	-	406.0399680	-	
Modulation rise time	(maximum)	50-250	µs	-	195.3	-	
	(minimum)	50-250	µs	-	169.3	-	
Modulation fall time	(maximum)	50-250	µs	-	196.7	-	
	(minimum)	50-250	µs	-	170.6	-	
Modulation phase deviation: positive	(maximum)	+ (1.0 to 1.2)	radians	-	1.1877	-	
	(minimum)	+ (1.0 to 1.2)	radians	-	1.0134	-	
Modulation phase deviation: negative	(maximum)	- (1.0 to 1.2)	radians	-	-1.1936	-	
	(minimum)	- (1.0 to 1.2)	radians	-	-1.0198	-	
Modulation symmetry measurement		≤ 0.05		-	0.0198	-	
Digital Message		correct	P / F	-	P	-	

Parameters to be Measured	Range of Specification	Units	Test Results			Comments
			Tmin	Tamb	Tmax	
			(-20°C)	(+21°C)	(+55°C)	
8(a). Self-test Mode						**Result: Pass**
Model: RLB-41, S/N: #15, TUV Ref: TSR0058 and Modification State 0						
Frame sync	011010000	P / F	-	P	P	
Format flag	1 / 0	bit value	-	1	1	
Single radiated burst	≤440 / 520 (±1%)	ms	-	439.978	439.977	
Default position data (if applicable)	correct	P / F	-	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	-	
Provides for 15 Hex ID	correct	P / F	-	P	-	
121.5 MHz RF power (if applicable)	verify that RF power emitted	P / F	-	P	-	
406 MHz power	verify that RF power emitted	P / F	-	P	-	
Distinct indication of Self-Test	provided	Y / N	-	Y	-	
Distinct indication of RF power being emitted	provided	Y / N	-	Y	-	On activation of the Self Test the following items are checked: Battery On Time RF Test Board Test. Various LED indications are provided which correlate to the pass / fail status of the above parameter checks. In accordance with the Operator Manual, if the third LED indicator is green, 406 MHz and 121 MHz power has been emitted. See also Annex B for further details.
Indication of Self-Test result	provided	Y / N	-	Y	-	
Maximum duration of Self-Test mode	≤ maximum duration of Self-Test	sec	-	10	-	
Automatic termination of Self-Test mode upon completion of Self-Test and indication of Self-Test results	verify automatic termination	Y / N	-	Y	-	

Parameters to be Measured	Range of Specification	Units	Test Results			Comments
			Tmin	Tamb	Tmax	
			(-20°C)	(+21°C)	(+55°C)	
8 (b). GNSS Self-Test Mode (if applicable)						**Result: Pass**
Model: RLB-41, S/N: #15, TUV Ref: TSR0058 and Modification State 0						
Frame sync	011010000	P / F	-	P	-	
Format flag	1 / 0	bit value	-	1	-	
Single radiated burst	≤ 520 (+1%)	ms	-	520.020	-	
Position data (if applicable)	must be within 500m (or 5.25km for User Location Protocol) of the actual position	P / F	-	P	-	
Design data showing how GNSS Self-test is limited in number of transmissions and duration	provided	Y / N		-		Applicants Data – Annex B
Single burst verification	one burst	P / F	-	P	-	
121.5 MHz RF power (if applicable)	GNSS self-test checks that RF power is emitted	Y / N		N		
406 MHz power	GNSS self-test checks that RF power is emitted	Y / N		Y		
Maximum duration of GNSS Self-test	-	s	-	132	-	Applicant's data: See Application Form
Actual duration of Self-test with encoded location	Less than maximum duration	s	-	45	-	
Maximum number of GNSS Self-tests (only beacons with internal navigation devices)	-	Number		-		Applicant's data: See Application Form
Distinct indication to register successful completion or failure of the GNSS self-test	must be provided	Y/N	-	Y	-	See comments in Test Results section
Distinct indication that a maximum number of GNSS self-tests has been attained after GNSS self-test mode activation and without transmission of a test message of further GNSS receiver current drain	must be provided	Y/N	-	Y	-	Applicants Data – Annex B

Parameters to be Measured	Range of Specification	Units	Test Results		Comments
9. Thermal Shock					**Result: Pass**
Model: RLB-41, S/N: #15, TUV Ref: TSR0058 and Modification State 0					
Soak Temperature	30°C difference	°C	20		
Measurement Temperature		°C	-10		
Transmitted Frequency			Min	Max	
Nominal value	C/S T.001	MHz	406.0400027	406.0400093	
Short-term stability	≤ $2x10^{-9}$	/100ms	57.334E-12	13.726E-11	
Medium-term stability – Slope	(-2 to +2)$x10^{-9}$	/min	-65.211E-12	96.163E-11	
Medium-term stability – Residual frequency variation	≤ $3x10^{-9}$		17.069E-11	92.930E-11	
Transmitter power output	35 - 39	dBm	38.02	38.10	
Digital message	correct	P/F	P		

Parameters to be Measured	Range of Specification	Units	Test Results				Comments
14. Satellite Qualitative Tests							**Result: Pass**
Model: RLB-41, S/N: #9, TUV Ref: TSR0064 and Modification State 0							
Test Configuration	As per C/S T.007		Configuration				
			5	6	7	8	
15 Hex ID Decoded by LUT	correct	P / F	-	-	-	P	
Doppler Location results with error ≤ 5km	≥ 80	%	-	-	-	100	

SPURIOUS EMISSION INTO 50 OHMS

Specification

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

Equipment Under Test and Modification State

RLB-41 S/N: #15 (TUV Ref TSR0058) - Modification State 0

Date of Test

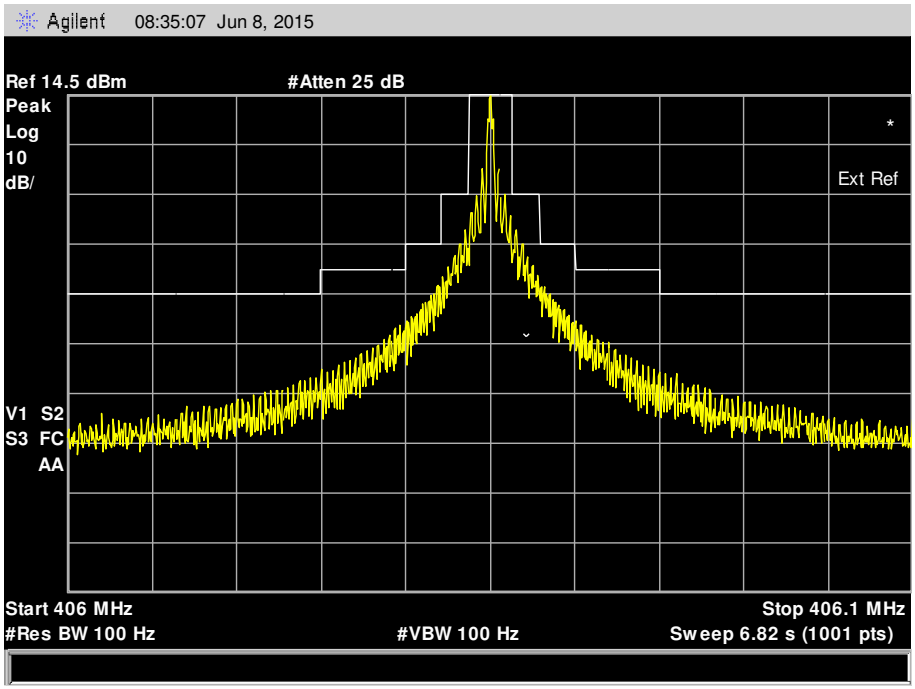
08 June 2015

Environmental Conditions

Ambient Temperature 22.6°C
Relative Humidity 30.8%

Test Results

Combined Ambient, Low and High Temperature



ANNEX B

CUSTOMER SUPPLIED INFORMATION

Product Service

October 19, 2015

Subject: ACR RLB-41 EPIRB Waiver Information

To Whom It May Concern:

ACR Electronics, Inc. hereby declares that all components and materials (including the labeling) on the exterior of the RLB-41 are of identical material used on the RLB-36, which has been fully tested and type approved, and has been in production for years. The only changes between the currently approved RLB-36 and the RLB-41 are in shape and internal to the EPIRB housing.

Based on the above information, ACR Electronics, Inc. requests that the following tests be waived:

TEST	IEC 61097-2: 2008	ETSI EN 300 066: 2001	AS/NZS 4280.1: 2003
Solar Radiation	A.2.7 (5.17.9)	6.11	5.5.1.2
Oil Resistance	A.2.8 (5.17.10)	6.12	5.5.1.2

Please feel free to contact me if additional information is required.

Signed on behalf of ACR Electronics, Inc.

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3M™ Scotchlite™ Reflective Material

SOLAS Grade Products

Description

3M™ Scotchlite™ Reflective Material – SOLAS (Safety of Life at Sea) Grade Products are intended for reflectorizing SOLAS life support equipment such as life vests, jackets, and rafts. It conforms to Marine Equipment Directive 96/98/EC and International Maritime Organization (IMO) Resolution A.658(16) Annex 2. It is approved by the U.S. Coast Guard to meet 46 CFR part 164, Subpart 164.018 for Type I and II retroreflective material used to enhance visibility of life-saving equipment in nighttime, or low-light conditions.

3M™ Scotchlite™ Reflective Material – SOLAS Grade Series 3100 products are silver, flexible reflective material with an aggressive pressure sensitive adhesive. 3M™ Scotchlite™ Reflective Material – SOLAS Grade 6755 is a silver, flexible reflective material with a sewable fabric backing while 3M™ Scotchlite™ Reflective Material – SOLAS Grade 6750-I has a sewable 4 mil polyester film backing.

These materials utilize the principle of retroreflection and are comprised of an encapsulated lens optical design that provides high reflectivity over a wide range of entrance angles, whether dry or wet. Scotchlite reflective material – SOLAS grade products have a European mark of conformance. All products are silver in color under daytime viewing conditions and reflect a bright white when illuminated by a light source.

Retroreflective Performance

The coefficient of retroreflection (R_A, in cd/lux/m²) is measured by methods traceable to either of the following retroreflective intensity testing procedures:

ASTM E809 and E810 (R_A)

CIE 54.2:2001 (R')

The following table contains the minimum R_A values as measured at the listed specific entrances and observations angles. Based on tests performed by 3M in accordance with IMO procedures and verified by an outside third party, Scotchlite reflective material – SOLAS grade products meet or exceed these values.

3M™ Scotchlite™ Reflective Material					
Entrance Angle	Observation Angle				
	0.1	0.2	0.5	1.0	2.0
5	180	175	72	14	2.5
30	140	135	70	12	2.0
45	85	85	48	9.4	1.0

Color

3M™ Scotchlite™ Reflective Material		
Product Number	Daytime Color	Reflected Color
3150-A, 3155, 6750-I, 6755	Silver	White