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Report On

GPS Testing of the
Oroila Limited
Z701 EPIRB
In accordance with IEC 61108-1

Document 75931946 Report 08 Issue 1

October 2017



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REPORT ON

GPS Testing of the
Oroila Limited
Z701 EPIRB

Document 75931946 Report 08 Issue 1

October 2017

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26 October 2017



Product Service

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SECTION 1

REPORT SUMMARY

GPS Testing of the
Oroila Limited
Z701 EPIRB



Product Service

1.1 INTRODUCTION

The information contained in this report is intended to show verification of the GPS Testing of the Oroila Limited Z701 EPIRB to the requirements of IEC 61108-1.

Objective	To perform GPS Testing to determine the Equipment Under Test's (EUT's) compliance with the Test Specification, for the series of tests carried out.
Manufacturer	Oroila Limited
Model Number(s)	Z701
Serial Number(s)	GPS #1
Number of Samples Tested	1
Test Specification/Issue/Date	IEC 61108-1 Second Edition 2003-07
Receipt of Test Samples	27 April 2017
Order Number	9556
Date	16 September 2016
Start of Test	29 April 2017
Finish of Test	29 September 2017
Name of Engineer(s)	A Guy
Related Documents	GPS SPS Performance Specification - USA DoD - 3rd Edition October 2001



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1.2 BRIEF SUMMARY OF RESULTS

A brief summary of results is shown below in accordance with IEC 61108-1: 2003.

Spec Clause	Test Description	Result	Comments
5.6.4.1.1*	Static accuracy - GPS	Pass	
5.6.4.2*	Angular movement of the antenna	Pass	
5.6.4.3.1*	Dynamic accuracy - GPS	Pass	
5.6.5.1*	Acquisition - Condition A - Initialization	Pass	
5.6.5.2*	Acquisition - Condition B - power outage	Pass	
5.6.5.3*	Acquisition - Condition C - Interruption of GPS signals	Pass	
5.6.5.4*	Acquisition - Condition D - Brief interruption of power	Pass	
5.6.6.1*	Protection - Antenna and input/output Connections	N/A	Test is Not Applicable; no antenna input is provided on the EUT.
5.6.8.1*	Sensitivity and dynamic range - Acquisition	Pass	
5.6.8.2	Sensitivity and dynamic range - Tracking	Pass	
5.6.9*	Effects of specific interfering signals	-	Refer to BSH document BSH_4542_001_4143066_17-GPS-TestReport
5.6.10.1	Position update - Slow speed update rate	Pass	
5.6.10.2	Position update - High speed update rate	Pass	
5.6.11	Differential GPS input	N/R	
5.6.12	Failure warnings and status indications	N/T	RAIM not enabled
5.6.13	Accuracy of COG and SOG	Pass	

Items marked * indicate that the IEC61108-1 clause identified is required by IEC61097-2 – the GMDSS EPIRB standard.

N/A: Not Applicable

N/R: Not Required

N/T: Not Tested



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1.3 DECLARATION OF BUILD STATUS

MAIN EUT			
MANUFACTURING DESCRIPTION	EPIRB		
MANUFACTURER	Orolia Ltd		
MODEL NAME/NUMBER	Z701		
PART NUMBER	23-100-001B		
HARDWARE VERSION	23-500-001B Issue A		
SOFTWARE VERSION	23-507Z Issue A		
TRANSMITTER FREQUENCY OPERATING RANGE (MHz)	406.04 MHz, 121.5 MHz, 161.975 MHz - 162.025 MHz		
RECEIVER FREQUENCY OPERATING RANGE (MHz)	N/A		
COUNTRY OF ORIGIN	UK		
INTERMEDIATE FREQUENCIES	N/A		
EMISSION DESIGNATOR(S): (i.e. G1D, GXW)			
MODULATION TYPES: (i.e. GMSK, QPSK)	Phase (16K0G1D), Swept tone AM (3K20A3X), Phase (16K0GXW),		
HIGHEST INTERNALLY GENERATED FREQUENCY	406 MHz		
OUTPUT POWER (W or dBm)	5W, 70mW, 1W		
FCC ID	KLS		
INDUSTRY CANADA ID	6913A		
TECHNICAL DESCRIPTION (a brief description of the intended use and operation)	Search and Rescue, transmits 406 MHz to alert rescue services, transmits AIS to alert local 3 rd parties of distress and 121.5 MHz for homing		
BATTERY/POWER SUPPLY			
MANUFACTURING DESCRIPTION	Internal Battery		
MANUFACTURER	Energizer		
TYPE	L91, AA		
PART NUMBER	Orolia Ltd P/N 23-105B		
VOLTAGE	9V		
COUNTRY OF ORIGIN	UK		
MODULES (if applicable)			
MANUFACTURING DESCRIPTION			
MANUFACTURER			
TYPE			
POWER			
FCC ID			
COUNTRY OF ORIGIN			
INDUSTRY CANADA ID			
EMISSION DESIGNATOR			
DHSS/FHSS/COMBINED OR OTHER			
ANCILLARIES (if applicable)			
MANUFACTURING DESCRIPTION			
MANUFACTURER			
TYPE			
PART NUMBER			
SERIAL NUMBER			
COUNTRY OF ORIGIN			

I hereby declare that the information supplied is correct and complete.

Name: Ruth Sims

Position held: R&D Manager

Signature:

Date: 20/10/17

1.4 PRODUCT INFORMATION

1.4.1 Technical Description

The Equipment Under Test (EUT) was an Orolia Limited Z701 EPIRB 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 EUT was configured as supplied by the customer, as follows:

EUT modification for test purposes only: see modification table.

The 406 MHz, 121 MHz homing and AIS transmitters were not operational during testing.

The NMEA sentence data was taken directly from the GPS module using fly leads soldered to the PCB. A short was placed on the PCB (see Manufacturers modification document) to allow continuous data output and override the GPS on/off duty cycle.

ID	Name	Details
A	Integral Antenna	The EUT was powered by its own batteries RS232 output to test laptop, "GNGGA" (various GPS sentences) EUT antenna fitted as in the production model See Figure 1, below.

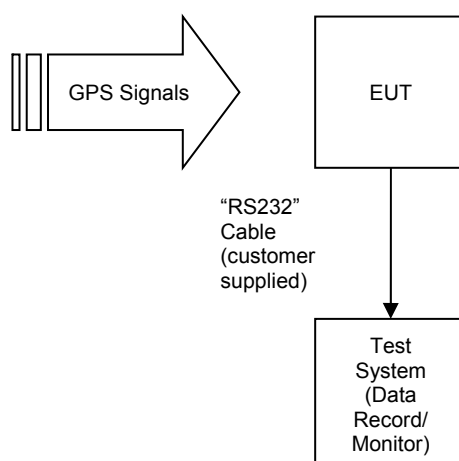


Figure 1: System Configuration A Schematic

The Test System was a laptop running Tera Term; a serial terminal program that records the NMEA output of the EUT and adds a timestamp (with a 1 ms resolution) to each sentence.

GPS Signals applied are recorded at the appropriate test section.

Physical setup was defined by the standard for Static Accuracy (and Angular Movement of the Antenna) tests. GPS Signal input was as per "live" (real world) conditions at the time/location.

Physical setup for the Sensitivity and Dynamic Range test (Acquisition and Tracking) was a function of the test chamber used. GPS Signal input level was as per details in the main test section.

The physical configuration for all other tests was as was most practical at the time. GPS signal input was checked using a reference receiver to provide enough for high (but not maximum*) signal-to-noise ratios (SNRs) on all Satellite Vehicles (SVs) in view. * I.e. attenuated down until SNRs began to drop then maintained.



Product Service

All relevant physical configurations are described or illustrated in the appropriate test section.

1.4.3 Modes of Operation

Modes of operation available on the EUT:

ID	Category	Name	Details
1	Operate	Operational	Depress On switch, EUT 406MHz/121.5MHz,162MHz [AIS system] activates
2	Off	Off	EUT powered down by pressing the OFF switch
3	Test	Self -test	Self-test switch depresses until the first green LED activated
4	Test	GNSS Self-test	Self-test switch depresses until the second green LED activated

Note: Modes, 1 and 2 was used for testing to the 61108 Standard.

1.4.4 Performance Check

The following definitions and requirements can be found within IEC 61108-1:

Clause 5.3 Standard Test Signals

"A "performance check" is defined as a shortened version of the static accuracy test described in 5.6.4.1, i.e. a minimum of 100 position measurements shall be taken over a period of not <5 min and not >10 min, discarding any measurements with HDOP ≥ 4 . The position of the antenna of the EUT shall not be in error compared with the known position by >100 m 95 % using WGS 84 as the reference datum."

Clause 4.3.3.1 Static Accuracy

"(M.112/A3.4) *The GPS receiver equipment shall have static accuracy such that the horizontal position of the antenna is determined to within 100 m (95 %) with horizontal dilution of precision (HDOP) ≤ 4 (or PDOP ≤ 6). Since Selective Availability has been set to zero, the static accuracy has been determined to be within 13 m (95 %) as specified by the GPS SPS Performance Standards of October 2001.*"



Product Service

Performance Check Procedure

For a Performance Check, the following actions were completed as appropriate to the test:

Action	Reported
General	
EUT provided with GPS signals	-
EUT allowed to acquire valid position (see Note 1)	Time to acquire valid position
Performance Check	
Check started	Start time/event of Performance Check
Check ended	Measurement duration
≥ 100 position solutions recorded	Total number of measurements
Measurements with HDOP ≥ 4 discarded (and, where stated, with PDOP ≥ 6)	Number of measurements with HDOP ≥ 4 (and PDOP ≥ 6)
Haversine (see Note 2) position error calculated	-
Proportion within tolerance calculated	Measurements with position error ≤ 13 m

Note 1: The term 'valid position' (also referenced as 'position lock' or 'lock' within this report) is defined as when the NMEA data GGA sentence reports "Position Quality" as any value between 1 and 8. EN 61162:2008 states that all GPS quality indicators in headings 1 through 8 are considered "valid". The heading "0" is the only "invalid" indicator.

Note 2: Earth's radius taken as 6367 km



Product Service

1.5 MODIFICATIONS

The table below details modifications made to the EUT during the test programme. The modifications incorporated during each test are recorded on the appropriate test pages.

Modification State	Description of Modification still fitted to EUT	Modification Fitted By	Date Modification Fitted
0	As supplied including (plastic non-conductive sleeve added around the PCB to reduce sensitivity to infrared radiation).	Manufacturer	07/11/2016
1*	The EUT was supplied with an RS232 cable connected to the GPS modules internal wiring	Orolia Limited	27 April 2017
2**	The EUT was fitted with a "Reset/Normal" Switch to be used in conjunction with 0*	Orolia Limited	30 May 2017

* Modification for testing purposes only: the RS232 cable was fitted to enable direct communication of the GNSS sentences transmitted from the GPS module

** This further modification was required to suppress the sleep/wake period of the GPS module / GPS controlling software.

General Note: Modifications 1* and 2** is a modification for test purposes only, neither modifications are fitted to the proposed EUT during manufacture of the fully packaged beacon.

1.6 REPORT MODIFICATION RECORD

Issue 1 – First Issue



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SECTION 2

TEST DETAILS

GPS Testing of the
Orolia Limited
Z701 EPIRB



Product Service

2.1 STATIC ACCURACY - GPS

2.1.1 Specification

IEC 61108-1, Clause 5.6.4.1.1

2.1.2 Equipment Under Test and Modification State

Z701 EPIRB S/N: EUT GPS#1 [TSR0084] - Modification State 2

2.1.3 Date of Test

20 & 21 September 2017

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 25.9 – 26.6 °C

Relative Humidity 45.8 – 60.8 %

2.1.6 Test Results

The following testing is required by the specification:

Static Test Site Clause 5.5.2 "Static Test Site"

"The antenna shall be mounted according to the manufacturer's instructions at a height of between 1 m and 1,5 m above the electrical ground in an area providing clear line of sight to the satellites from zenith through to an angle of +5° above horizontal. The position of the antenna shall be known, with reference to WGS 84 to an accuracy of better than 0,1 m in (x, y, z). Maximum cable lengths as specified by the manufacturer shall be used during testing.

All static tests shall utilize actual GPS signals."

Test Method Clause 5.6.4.1.1

"Position fix measurements shall be taken over a period of not <24 h. The absolute horizontal position accuracy shall be within 13 m (95 %), having discarded measurements taken in conditions of HDOP ≥ 4 and PDOP ≥ 6 ."

Performance Standard Clause 4.3.3.1

"(M.112/A3.4) *The GPS receiver equipment shall have static accuracy such that the horizontal position of the antenna is determined to within 100 m (95 %) with horizontal dilution of precision (HDOP) ≤ 4 (or PDOP ≤ 6).* Since Selective Availability has been set to zero, the static accuracy has been determined to be within 13 m (95 %) as specified by the GPS SPS Performance Standards of October 2001."

2.1.7 Test Setup



Test Setup

2.1.8 Test Results

EUT was placed on the static test site on a non-conductive platform. It was operated and monitored continuously for the period of measurement as below. A Performance Check was conducted on the monitored data; results were as follows:

Test Parameter	Units	Result	Limit
Test Specific			
Non-conductive platform height	m	1.34	1 to 1.5
General			
Time to acquire valid position	s	31.5	-
Performance Check			
Start time/event of Performance Check	-	Position Lock	-
Measurement duration	h	24.16	>24
Total number of position solutions	-	86432	-
Number of solutions with HDOP ≤ 4 and PDOP ≤ 6	-	86432	-
Measurements with position error ≤ 13 m	%	100	≥ 95



Product Service

2.2 STATIC ACCURACY - GPS - ANGULAR MOVEMENT OF THE ANTENNA

2.2.1 Specification

IEC 61108-1, Clause 5.6.4.2

2.2.2 Equipment Under Test and Modification State

Z701 EPIRB S/N: EUT GPS#1 [TSR0084] - Modification State 2

2.2.3 Date of Test

25 & 26 September 2017

2.2.4 Test Equipment Used

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

2.2.5 Environmental Conditions

Ambient Temperature 28.3 – 31.8 °C

Relative Humidity 34.7 – 42.4 %

2.2.6 Test Method

The following testing is required by the specification:

Test Method Clause 5.6.4.2:

“The static tests specified in 5.6.4.1.1 and 5.6.4.1.2 shall be repeated with the antenna performing an angular displacement of $\pm 22.5^\circ$ (simulating roll) in a period of about 8 s (see IEC 60721-3-6) during the duration of the tests.

The results shall be as in 5.6.4.1.1 and 5.6.4.1.2.”

Performance Standard Clause 4.3.3.1

“(M.112/A3.4) *The GPS receiver equipment shall have static accuracy such that the horizontal position of the antenna is determined to within 100 m (95 %) with horizontal dilution of precision (HDOP) ≤ 4 (or PDOP ≤ 6). Since Selective Availability has been set to zero, the static accuracy has been determined to be within 13 m (95 %) as specified by the GPS SPS Performance Standards of October 2001.*”

2.2.7 Test Setup



Test Setup

2.2.8 Test Results

EUT was placed on the static test site on a non-conductive platform oscillating $\pm 22.5^\circ$ from the vertical with a period of approximately 8 seconds. It was operated and monitored continuously for the measurement duration as below. A Performance Check was conducted on the monitored data; results were as follows:

Test Parameter	Units	Result	Limit
Test Specific			
Non-conductive platform height	m	1.34	1 to 1.5
General			
Time to acquire valid position	s	26.0	-
Performance Check			
Start time/event of Performance Check	-	Position Lock	-
Measurement duration	h	24.02	>24
Total number of position solutions	-	86402	-
Number of solutions with HDOP ≤ 4 and PDOP ≤ 6	-	86402	-
Measurements with position error ≤ 13 m	%	99.0	≥ 95



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2.3 DYNAMIC ACCURACY - GPS

2.3.1 Specification

IEC 61108-1, Clause 5.6.4.3.1

2.3.2 Equipment Under Test and Modification State

Z701 EPIRB S/N: EUT GPS#1 [TSR0084] - Modification State 2

2.3.3 Date of Test

23 September 2017

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 22.7 °C

Relative Humidity 43.9 %

2.3.6 Test Method

IEC 61108-1: 2003, Clause 5.6.4.3.1:

“The tests for dynamic accuracy are a practical interpretation of the conditions set out in IEC 60721-3-6, Table V, item e), X – direction (surge) and Y – direction (sway). These are

stated as surge 5 m/s² and sway 6 m/s² for all classes of environment. When using a simulator, the simulator characteristics shall accurately represent the signals required.

The results of the test performed by simulation facilities shall be identical with those in a) and b) below. [...]

a) a fully locked and settled EUT travelling in a straight line at 48 knots $\pm$ 2 knots for a minimum of 1,2 min which is reduced to 0 knots in the same straight line in 5 s [...]

b) a fully locked and settled EUT travelling at least 100 m at 24 knots $\pm$ 1 knot in a straight line then subjected, for at least 2 min, to smooth deviations either side of the straight line of approximately 2 m at a period of 11 s to 12 s[...]

2.3.7 Test Setup



Test Setup



Product Service

2.3.8 Test Results

Dynamic Accuracy A

EUT and GPS simulator were started simultaneously and the EUT acquired a position lock after the acquisition time stated in the table below; the simulator ran a dynamic position travelling at 48 knots in a straight line for 10 minutes before decelerating to 0 knots in 5 seconds (in the same straight line). The position output 10 seconds after coming to rest was determined from the NMEA 0183 output. A short Performance Check was then performed for information.

Test Parameter	Units	Result	Limit
General			
Signal type	Live/Simulated	Simulated	-
EUT started simultaneously	Y/N	Y	-
Time to acquire valid position	s	30.4	-
Test Specific			
Position Error 10 s after coming to rest	m	1.86	< 13
Performance Check			
Start time/event of Performance Check	-	10 s after scenario comes to rest	-
Measurement duration	min	10.0	-
Total number of position solutions	-	601	-
Number of solutions with HDOP ≤ 4 and PDOP ≤ 6	-	601	-
Measurements with position error ≤ 13 m	%	100	-



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Dynamic Accuracy B

EUT and GPS simulator were started simultaneously and the EUT acquired a position lock after the acquisition time stated in the table below; the simulator ran a dynamic position travelling at 24 knots in a straight line for 10 minutes before starting to oscillate smoothly ± 2 m either side of the original path for a further 20 minutes.

EUT position output error compared to the simulated dynamic position was determined from the EUT NMEA output.

*A Modified Performance Check was conducted during the 20-minute oscillation period in order to determine that the position error was not outside of the ± 15 m 'lane' of tolerance. Hence, the Performance Check differs from normal in position error limit, which is set to 100 % within ± 15 m.

Test Parameter	Units	Result	Limit
General			
Signal type	Live/Simulated	Simulated	-
EUT started simultaneously	Y/N	Y	-
Initial Acquisition Time	s	58.8	-
Test Specific			
Modified Performance Check result	P/F	P	P
Modified Performance Check			
Start time/event of Performance Check	-	Start of oscillation	-
Total number of measurements	-	601	-
Number of solutions with HDOP ≤ 4 and PDOP ≤ 6	-	601	≥ 100
Measurement duration	min	10	> 2
Measurements with position error ≤ 15 m *	%	100	100



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2.4 ACQUISITION - CONDITION A – INITIALIZATION

2.4.1 Specification

IEC 61108-1, Clause 5.6.5.1

2.4.2 Equipment Under Test and Modification State

Z701 EPIRB S/N: EUT GPS#1 [TSR0084] - Modification State 2

2.4.3 Date of Test

17 July 2017

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 22.1 °C

Relative Humidity 44.2 %

2.4.6 Test Method

The following testing is required by the specification:

Test Method Clause 5.6.5.1

“The EUT shall be either:

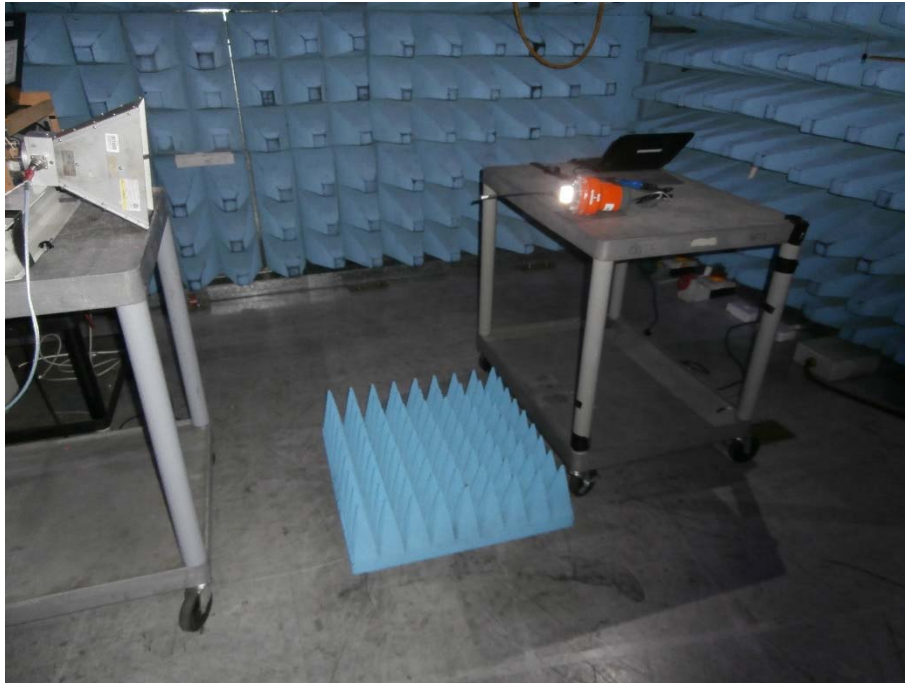
- a) initialized to a false position at least 1 000 km and not greater than 10 000 km from the test position, or alternatively, by deletion of the current almanac; or
- b) isolated from a power source for >7 days.

A performance check shall be carried out after the time limit contained in Table 1.”

Performance Standard Clause 4.3.4

“(M.112/A3.8) *The GPS receiver equipment shall be capable of acquiring position to the required accuracy, within 30 min, when there is no valid almanac data.*”

2.4.7 Test Setup



Test Setup

2.4.8 Test Results

EUT was initialised at a false position as per the table below.

The time to position lock was measured and a Performance Check was started once position lock was obtained. The simulator ran a static position for sufficient time for the test to complete. Results of the Performance Check follow.

Test Parameter	Units	Result	Limit
Test Specific			
False position difference from test position	km	1679	1,000 to 10,000
Time to acquire valid position	min	0.6	< 30
Performance Check			
Start time/event of Performance Check	-	Position Lock	-
Measurement duration	min	10.00	≥ 5 and ≤ 10
Total number of position solutions	-	596	-
Number of solutions with HDOP ≤ 4 and PDOP ≤ 6	-	596	≥ 100
Measurements with position error ≤ 13 m	%	100	≥ 95



Product Service

2.5 ACQUISITION - CONDITION B - POWER OUTAGE

2.5.1 Specification

IEC 61108-1, Clause 5.6.5.2

2.5.2 Equipment Under Test and Modification State

Z701 EPIRB S/N: EUT GPS#1 (TSR0084) - Modification State 1

2.5.3 Date of Test

29 & 30 April 2017

2.5.4 Test Equipment Used

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

2.5.5 Environmental Conditions

Ambient Temperature 19.2 – 22.4 °C

Relative Humidity 45.8 – 56.1 %

2.5.6 Test Method

The following testing is required by the specification:

Test Method Clause 5.6.5.2

“The EUT shall be isolated from the power source for a period within 24 h to 25 h.
At the end of the period, a performance check shall be carried out after the time limit contained in Table 1.”

Performance Standard Clause 4.3.4

“(M.112/A3.9) The GPS receiver equipment shall be capable of acquiring position to the required accuracy, within 5 min, when there is valid almanac data.”

2.5.7 Test Setup



Test Setup

2.5.8 Test Results

EUT was position-locked and stable when the power was removed for the “Power isolation period”, as below, then re-applied.

Test Parameter	Units	Result	Limit
Test Specific			
Power isolation period	h	24.16	≥ 24 and ≤ 25
Time to acquire valid position	min	0.5	≤ 5
Performance Check			
Start time/event of Performance Check	-	Position Lock	-
Measurement duration	min	10.00	≥ 5 and ≤ 10
Total number of position solutions	-	601	-
Number of solutions with HDOP ≤ 4 and PDOP ≤ 6	-	596	≥ 100
Measurements with position error ≤ 13 m	%	100	≥ 95

Note: This was the only full test performed without the “Reset/Normal” switch.



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2.6 ACQUISITION - CONDITION C - INTERRUPTION OF GPS SIGNALS

2.6.1 Specification

IEC 61108-1, Clause 5.6.5.3

2.6.2 Equipment Under Test and Modification State

Z701 EPIRB S/N: EUT GPS#1 [TSR0084] - Modification State 2

2.6.3 Date of Test

30 & 31 July 2017

2.6.4 Test Equipment Used

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

2.6.5 Environmental Conditions

Ambient Temperature 20.8 to 21.4 °C

Relative Humidity 47.2 to 52.1 %

2.6.6 Test Method

The following testing is required by the specification:

Test Method Clause 5.6.5.3

“During normal operation of the EUT, the antenna shall be completely masked for a period between 24 h and 25 h.

At the end of the period, a performance check shall be carried out after the time limit contained in Table 1.”

Performance Standard Clause 4.3.4

“(M.112/A3.10) *The GPS receiver equipment shall be capable of re-acquiring position to the required accuracy, within 5 min, when the GPS signals are interrupted for a period of at least 24 h, but there is no loss of power.*”

2.6.7 Test Setup



Test Setup

2.6.8 Test Results

EUT was locked and stable and the GPS Signals were removed for the “GPS signal isolation period”. Upon reapplication of GPS signals the (re)acquisition time was measured and a performance check performed.

Test Parameter	Units	Result	Limit
Test Specific			
GPS signal isolation period	hours	24.03	≥ 24 and ≤ 25
Time to acquire valid position	min	1.03	≤ 5
Performance Check			
Start time/event of Performance Check	-	Re-acquisition	-
Measurement duration	min	10.00	≥ 5 and ≤ 10
Total number of position solutions	-	601	-
Number of solutions with HDOP ≤ 4 and PDOP ≤ 6	-	591	≥ 100
Measurements with position error ≤ 13 m	%	100	≥ 95



Product Service

2.7 ACQUISITION - CONDITION D – BRIEF INTERRUPTION OF POWER

2.7.1 Specification

IEC 61108-1, Clause 5.6.5.4

2.7.2 Equipment Under Test and Modification State

Z701 EPIRB S/N: EUT GPS#1 [TSR0084] - Modification State 2

2.7.3 Date of Test

17 July 2017

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 22.1 °C

Relative Humidity 44.2 %

2.7.6 Test Method

The following testing is required by the specification:

Test Method Clause 5.6.5.4

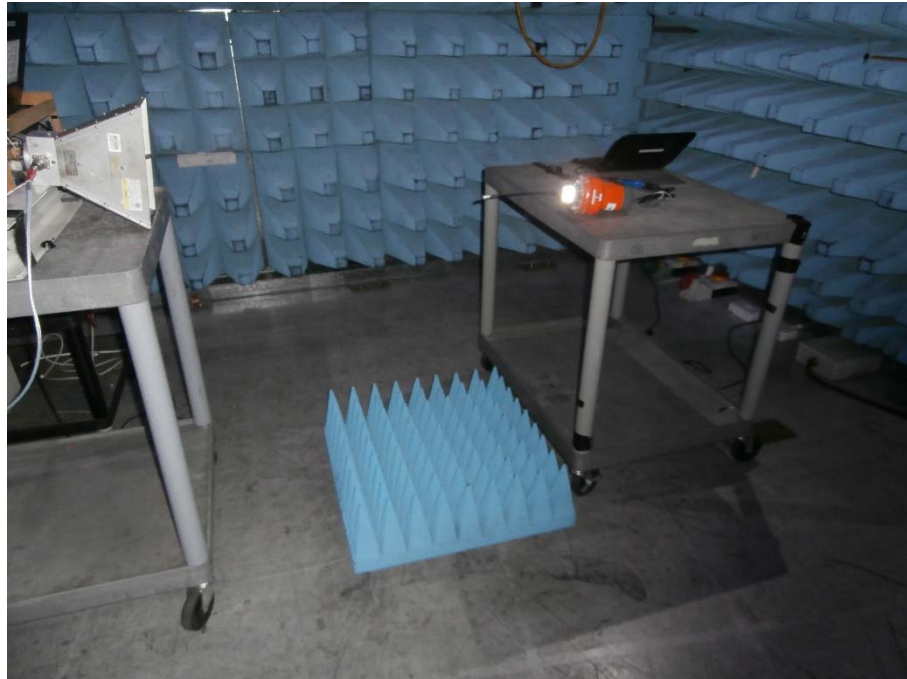
“During normal operation of the EUT, the power shall be removed for a period of 60 s. At the end of this period, the power shall be restored.

A performance check shall be carried out after the time limit contained in Table 1.”

Performance Standard Clause 4.3.4

“(M.112/A3.11) *The GPS receiver equipment shall be capable of re-acquiring position to the required accuracy, within 2 min, when subjected to a power interruption of 60 s.*”

2.7.7 Test Setup



Test Setup

2.7.8 Test Results

EUT was locked and stable and the Power was removed for a “Power isolation period”. Power was reapplied and the time to re-acquire was measured. A Performance Check was started once position lock was obtained.

Test Parameter	Units	Result	Limit
Test Specific			
Power isolation period	sec	65	60
Re-acquisition time	min	0.63	≤ 2
Performance Check			
Start time/event of Performance Check	-	Position Lock	-
Measurement duration	min	9.98	≥ 5 and ≤ 10
Total number of position solutions	-	591	-
Number of solutions with HDOP ≤ 4 and PDOP ≤ 6	-	591	≥ 100
Measurements with position error ≤ 13 m	%	100	≥ 95



Product Service

2.8 SENSITIVITY AND DYNAMIC RANGE - ACQUISITION

2.8.1 Specification

IEC 61108-1, Clause 5.6.8.1

2.8.2 Equipment Under Test and Modification State

Z701 EPIRB S/N: EUT GPS#1 [TSR0084] - Modification State 2

2.8.3 Date of Test

23 September 2017

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 21.7 °C

Relative Humidity 46.2 %

2.8.6 Test Method

The following testing is required by the standard:

Test Method Clause 5.6.8.1

- a) Transmit the simulator signal over a suitable antenna.
- b) Adjust the signal power by use of a calibrated test receiver to $-125 \text{ dBm} \pm 5 \text{ dBm}$.
- c) Replace the antenna of the calibrated test receiver by the receiving unit of the EUT.
- d) A performance check shall be carried out."

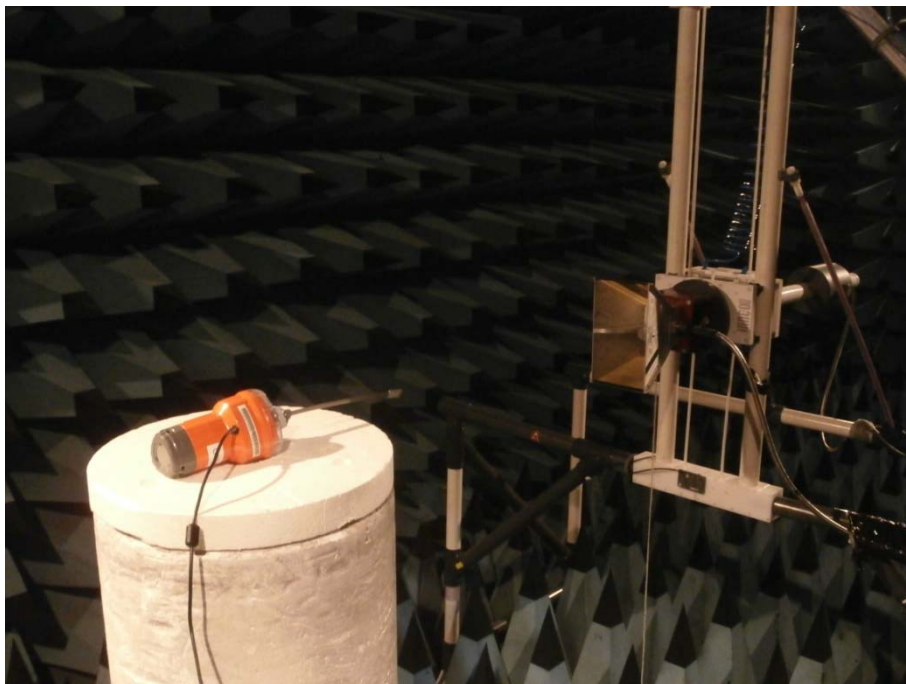
Performance Standard Clause 4.3.7

"(M.112/A3.7) The GPS receiver equipment shall be capable of acquiring satellite signals with input signals having carrier levels in the range of -130 dBm to -120 dBm as measured at the output of a 3 dBi linear polarized receiving antenna. Once the satellite signals have been acquired the equipment shall continue to operate satisfactorily with satellite signals having carrier levels down to -133 dBm as measured at the output of a 3 dBi linear polarized receiving antenna."

Performance Standard Clause 5.6.8.1

"The EUT shall meet the requirements of this check, within this signal range."

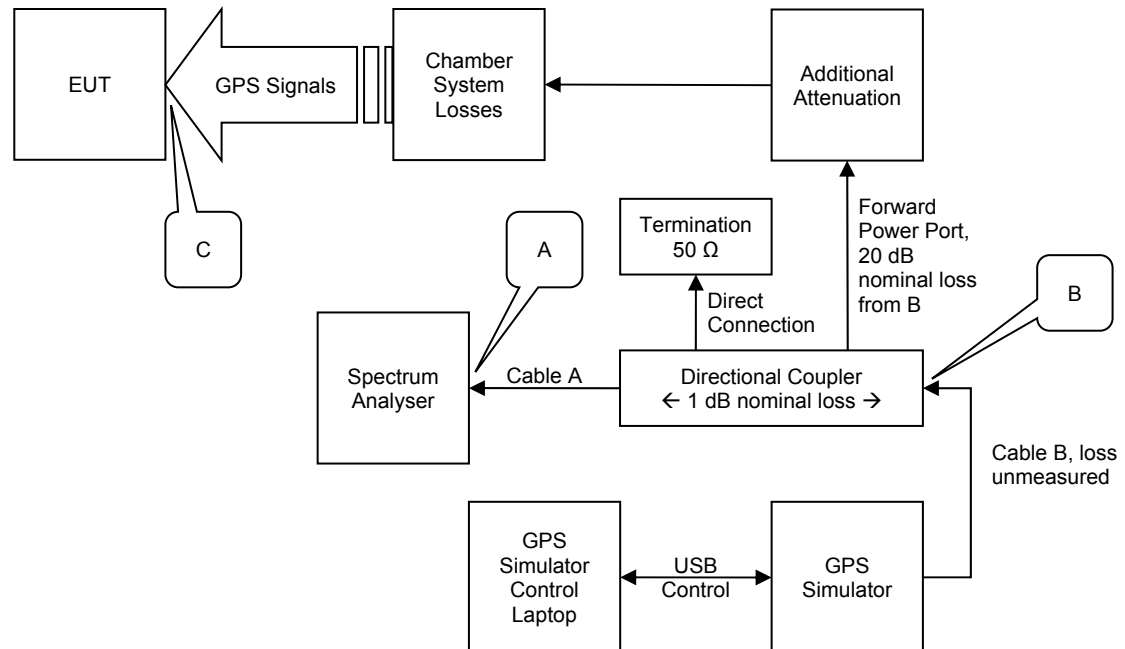
2.8.7 Test Setup



Test Setup

Calibrated Field Setup

The test is set up as per the following schematic:



Field Calibration Schematic

The basic premise of the Field Calibration procedure is that power at C equals power at B minus the loss from B to C. Power at B equals the power at A plus the loss A to B.



Product Service

2.8.8 Test Results

The EUT was activated in the above test setup, acquisition time was measured and a Performance Check was performed.

Test Parameter	Units	Result	Limit
Test Setup Variables			
Received signal strength	dBm	-125.62	-125 ± 5
General			
Initial acquisition time	s	36.021	(See Note 1)
Performance Check			
Start time/event of Performance Check	-	Position lock	-
Measurement duration	min	10.00	≥ 5 and ≤ 10
Total number of measurements	-	601	-
Number of solutions with HDOP ≤ 4 and PDOP ≤ 6	-	601	≥ 100
Measurements with position error ≤ 13 m	%	100	≥ 95

Note 1: EUT must acquire a position (in order to complete Performance Check); however, no time limit is explicitly defined.



Product Service

2.9 SENSITIVITY AND DYNAMIC RANGE - TRACKING

2.9.1 Specification

IEC 61108-1, Clause 5.6.8.2

2.9.2 Equipment Under Test and Modification State

Z701 EPIRB S/N: EUT GPS#1 [TSR0084] - Modification State 2

2.9.3 Date of Test

23 September 2017

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 21.7 °C
Relative Humidity 46.2 %

2.9.6 Test Method

The following testing is required by the standard:

Test Method Clause 5.6.8.2

[As per Clause 5.6.8.1 except:]

“d) After the start of transmission and tracking with the nominal transmission level condition, gradually reduce transmission level down to –133 dBm.”

Performance Standard Clause 5.6.8.1

“The EUT shall continue tracking at least one satellite.

2.9.7 Test Setup

The initial test setup was identical to “Sensitivity and Dynamic Range - Acquisition”. The final setup (post-signal reduction procedure) was as per test results, below.

2.9.8 Test Results

EUT remained operational after the Sensitivity and Dynamic Range - Acquisition test in "Normal Operation"; locked and settled having just completed a Performance Check. Signal power was then reduced gradually reduced as per the "Signal reduction procedure".

Parameter	Units	Result	Limit
Signal Reduction Procedure			
Received signal strength (per SV) - Initial	dBm	As per Sensitivity and Dynamic Range - Acquisition	-125 ± 5
Received signal strength (per SV) - Final	dBm	-133.64	-133
Reduction increments	dB	1.0	see Note 1
Reduction procedure duration	min	4.0	see Note 1
Satellites in scenario	-	9	-
Required Results - EUT Response			
Satellites tracked	-	8	≥ 1

Note 1: Requirement is "gradual"



Product Service

2.10 POSITION UPDATE - SLOW SPEED UPDATE RATE

2.10.1 Specification

IEC 61108-1, Clause 5.6.10.1

2.10.2 Equipment Under Test and Modification State

Z701 EPIRB S/N: EUT GPS#1 [TSR0084] - Modification State 2

2.10.3 Date of Test

23 September 2017

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 21.3 °C

Relative Humidity 45.9 %

2.10.6 Test Method

Test Method Clause 5.6.10.1

“The EUT shall be placed upon a platform, moving in approximately a straight line, at a speed of 5 knots $\pm$ 1 knot. The position output of the EUT shall be checked at intervals of 10 s, over a period of 10 min. The output position shall be observed to be updated on each occasion.

This test may be carried out by using a simulator.

[...]

Record the IEC 61162 output of the EUT during this test and confirm that received positions at the end of each interval are in compliance with the real or simulated reference position.”

Performance Standard Clause 4.3.9

“(M.112/A3.12) *The GPS receiver equipment shall generate and output to a display and digital interface a new position solution at least once every 1 s.*

NOTE For craft meeting the HSC code, a new position solution at least every 0,5 s is recommended.

(M.112/A3.13) *The minimum resolution of position i.e. latitude and longitude shall be 0,001 min.”*

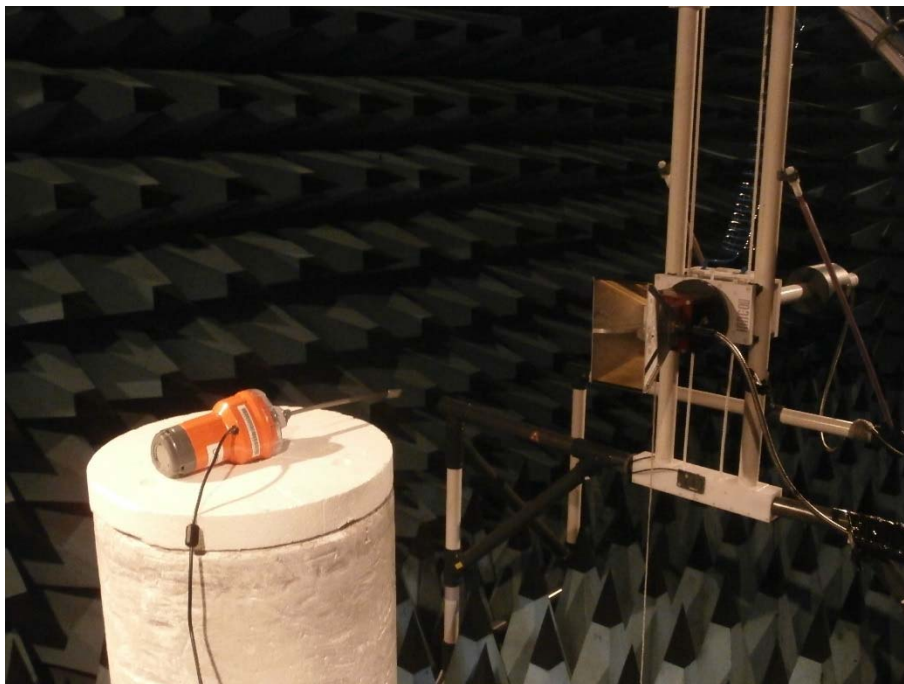
Performance Standard Clause 5.6.10.1

“The position output of the EUT shall be checked at intervals of 10 s, over a period of 10 min. The output position shall be observed to be updated on each occasion”

Performance Standard Clause 5.6.10.2

“[...] confirm that received positions at the end of each interval are in compliance with the real or simulated reference position.”

2.10.7 Test Setup



Test Setup

2.10.8 Test Results

EUT was locked and settled on a static simulated position; the simulated scenario then began a period of motion at the speed stated in the table below. During an observation period, the time between position output messages and time between position updates was checked.

Test Parameter	Units	Result	Limit
General			
Time to acquire valid position	s	31.65	-
Test Specific			
Scenario velocity	knot	4.86	
Minimum position change (min[dLat+dLon])	Decimal degrees	1.0×10^{-06}	> 0 (Note 1)
Maximum position update interval	s	1.014	≤ 10
Sample latitude field value	DDMM.X	5051.01833	Resolution must be to 0.001
Sample longitude field value	DDDMM.X	00108.61705	Resolution must be to 0.001
Performance Check			
Start time/event of Performance Check	-	Start of steady velocity	-
Measurement duration	min	10.00	10
Total number of position solutions	-	601	-
Number of solutions with HDOP ≤ 4 and PDOP ≤ 6	-	601	≥ 100
Measurements with position error ≤ 13 m ***	%	100	≥ 95

Note 1: If the minimum position change were zero, it would indicate that the position output was not updated; hence, any result above zero indicates that the position was updated at every output.



Product Service

2.11 POSITION UPDATE - HIGH SPEED UPDATE RATE

2.11.1 Specification

IEC 61108-1, Clause 5.6.10.2

2.11.2 Equipment Under Test and Modification State

Z701 EPIRB S/N: EUT GPS#1 [TSR0084] - Modification State 2

2.11.3 Date of Test

23 September 2017

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 21.3 °C

Relative Humidity 45.9 %

2.11.6 Test Method

The following testing is required by the standard:

Test Method Clause 5.6.10.2

"The EUT shall be placed upon a platform, moving in approximately a straight line, at a speed of 50 knots $\pm$ 5 knots. The position output of the EUT shall be checked at intervals of 1 s, over a period of 10 min. The output position shall be observed to be updated on each occasion.

This test may be carried out by using a simulator with a speed of 70 knots at intervals of 0,5 s.

[...]

Record the IEC 61162 output of the EUT during this test and confirm that received positions at the end of each interval are in compliance with the real or simulated reference position."

Performance Standard Clause 4.3.9

"(M.112/A3.12) The GPS receiver equipment shall generate and output to a display and digital interface a new position solution at least once every 1 s.

NOTE For craft meeting the HSC code, a new position solution at least every 0,5 s is recommended.

(M.112/A3.13) The minimum resolution of position i.e. latitude and longitude shall be 0,001 min."

Performance Standard Clause 5.6.10.2

“The position output of the EUT shall be checked at intervals of 1 s, over a period of 10 min. The output position shall be observed to be updated on each occasion.

[...] confirm that received positions at the end of each interval are in compliance with the real or simulated reference position.”

2.11.7 Test Setup



Test Setup



2.11.8 Test Results

EUT was locked and settled on a scenario simulating motion at the speed indicated in the table below. During an observation period of 10 minutes, the time between position output messages and time between position updates was checked. Minimum/maximum values (as appropriate) are recorded in the table below.

A Performance Check was carried out during the observation period to confirm that the received positions complied with the simulated position, results follow.

Test Parameter	Units	Result	Limit
General			
Time to acquire valid position	s	30.685	-
Test Specific			
Scenario velocity	knot	70.00	
Minimum position change (min[dLat+dLon])	Decimal degrees	0.000511	> 0 (Note 1)
Maximum position update interval	s	1.014	-
Sample latitude field value	DDMM.X	5052.99743	Resolution must be to 0.001
Sample longitude field value	DDMMM.X	00110.65925	Resolution must be to 0.001
Performance Check			
Start time/event of Performance Check	-	Position lock	-
Measurement duration	min	10.00	10
Total number of position solutions	-	601	-
Number of solutions with HDOP ≤ 4 and PDOP ≤ 6	-	601	≥ 100
Measurements with position error ≤ 13 m ****	%	100	≥ 95

Note 1: If the minimum position change were zero, it would indicate that the position output was not updated; hence, any result above zero indicates that the position was updated at every output.



Product Service

2.12 ACCURACY OF COG AND SOG

2.12.1 Specification

IEC 61108-1, Clause 5.6.10.2

2.12.2 Equipment Under Test and Modification State

Z701 EPIRB S/N: EUT GPS#1 [TSR0084] - Modification State 2

2.12.3 Date of Test

23 September 2017

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 22.2 °C

Relative Humidity 46.8 %

2.12.6 Test Method

Test Method and Performance Standard ("Accuracy of COG and SOG") Clause 5.6.13

"The EUT shall be set up on an appropriate mobile unit or simulator and all outputs indicating course over ground shall be monitored.

At a constant forward direction, the forward speed shall be within 0 knots to 1 knot. Ten seconds after being in the range [interpreted as the GGA sentence indicating lock and applied speed being steady.], measurements shall be made for a duration of 2 min. This cycle shall be repeated for all speed ranges of the Table 2 above.

Required results

[...]

For SOG tests, no reading of the speed indicator shall differ from the constant speed being applied at the time by more than 2 % of that speed or 0,2 knots, whichever is the greater.

For COG tests, the differences between the reference direction and measured course over ground of in each test cycle shall not exceed the limits of Table 2."

Performance Standard ("Accuracy of COG") Clause 4.3.12.1

"The error in the COG (the path of the antenna position over ground) due to the actual ship's speed over ground shall not exceed the following values:

Table 2 – Accuracy of COG

Speed range (knots)	Accuracy of COG output to user
0 to ≤1 knot	Unreliable or not available
>1 to ≤17 knots	±3°
>17 knots	±1°

Due to the limitations of GPS receivers of this standard, it is not appropriate to include requirements for COG errors attributed to high dynamic movement. Such limitations shall be in the manufacturer's operational manual."

Performance Standard ("Accuracy of SOG Information") Clause 4.3.12.2

"Errors in the SOG (velocity of the antenna position over ground) shall not exceed 2 % of the actual speed or 0,2 knots, whichever is greater."

Test Method and Performance Standard ("Validity of COG and SOG") Clause 5.6.13

"The quality indicator of the GGA and VTG message of IEC 61162 shall be used for interpretation of validity of COG and SOG."

Method of testing

Check of digital interface with IEC 61162. With the EUT normally operating, preclude invalid position data by reducing the number of received satellites. Investigate the content of the resultant GGA and VTG."

Required result

Observe that the quality indicators of GGA and VTG messages of IEC 61162 turn to invalid. Observe that the COG and SOG information contained in VTG message of IEC 61162 is replaced by null fields."

2.12.7 Test Setup



Test Setup

2.12.8 Test Results

Accuracy of COG and SOG - General

EUT was locked and settled on a scenario simulating motion at constant speed and direction. During a two-minute period of observation started 10 seconds after being in the range* the COG and SOG were checked (in the sentence output) against the requirements.

* "Being in the range" was taken to mean that both of the following criteria were met: The position solution was locked and stable and the simulated speed was stable.

The relevant applied COG and SOG, the sentence type (three-letter mnemonic) and the maximum COG and SOG outputs are recorded in the tables below.



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Accuracy of COG and SOG - 0 knots to 1 knot

Test Parameter	Units	Result	Limit
Simulated Course over Ground	° (True)	N/A	-
Simulated Speed over Ground	knots	0	0 to ≤ 1
Sentence type	-	RMC	VTG or RMC
Max COG Error	° (True)	0	0 *
Max SOG Error	knots	0.071	0.2

* Where a null field occurred, an error value of 0 was calculated. Any field that was not null/unreliable/not available would count as an error.

Accuracy of COG and SOG - 1 knot to 17 knots

Test Parameter	Units	Result	Limit
Simulated Course over Ground	° (True)	90.00	-
Simulated Speed over Ground	knots	4.438	1 to ≤ 17
Sentence type	-	RMC	VTG or RMC
Max COG Error	° (True)	0.26	3
Max SOG Error	knots	0.02	0.2

Accuracy of COG and SOG - Over 17 knots

Test Parameter	Units	Result	Limit
Simulated Course over Ground	° (True)	90.00	-
Simulated Speed over Ground	knots	19.438	> 17
Sentence type	-	RMC	VTG or RMC
Max COG Error	° (True)	0.09	1
Max SOG Error	knots	0.031	0.389

Validity of COG and SOG

At the end of the 17+ knots test, the satellite signals were removed, one SV at a time, until only two remained (insufficient for a position lock). The GGA and RMC validity flags were observed to turn to invalid and the COG and SOG fields were observed to all be null.



Product Service

SECTION 3

TEST EQUIPMENT USED



Product Service

3.1 TEST EQUIPMENT

Instrument	Manufacturer	Type No.	TE No.	Calibration Period (months)	Calibration Due
Sections 2.1 Beacons - GNSS Static Accuracy					
Hygrometer	Rotronic	A1	2677	12	24-Jan-2018
True RMS Multimeter	Fluke	179	4007	12	14-Sept-2018
Sections 2.2, 2.3, 2.4, 2.5, 2.6, 2.7, 2.8, 2.9, 2.10, 2.11 - GNSS Tests					
Antenna (Double Ridge Guide, 1GHz-18GHz)	EMCO	3115	235	22	2-Dec-2017
Attenuator (10dB, 10W)	Weinschel	23-10-34	470	12	04-Dec-2017
Spectrum Analyser	Agilent Technologies	E4407B	1154	12	25-Oct-2017
Attenuator (10dB, 10W)	Trilithic	HFP-50N	1377	12	25-Oct-2017
Programmable Power Supply	Iso-tech	IPS 2010	2436	-	O/P Mon
GPS/SBAS Simulator	Spirent	STR4500	3056	-	30-Sept-2017
Beacon Tester	WS Technologies	BT 100S	87	-	TU
Attenuator (20dB, 10W)	Aeroflex / Weinschel	23-20-34	3160	12	02-Aug-2018
0.92 to 2.2 GHz Coupler	Narda	3042B	4472	12	8-Dec-2017
Antenna (Double Ridge Guide)	EMCO	3115	34	12	2-Dec-2017
Termination (50ohm)	Diamond Antenna	DL-30N	341	12	12-Jan-2018
Spectrum Analyser	Agilent Technologies	E7405A	1410	12	23-Aug-2018
Screened Room (8)	Rainford	Rainford	1548	-	TU
Screened Room (1)	Rainford	Rainford	1541	-	TU
Programmable Power Supply	Iso-tech	IPS 2010	2437	-	O/P Mon
Stop Clock	R.S Components	RS328 061	2674	12	13-Jul-2018
Hygrometer	Rotronic	I-1000	2882	12	24-Nov-2017
GPS/SBAS Simulator	Spirent	STR4500	3056	-	30-Sept-2017
Multi-GNSS Simulator (GPS)	Spirent	GSS6700	4596	12	11-Aug-2018
Attenuator (20dB, 10W)	Aeroflex / Weinschel	23-20-34	3159	12	21-Jun-2018
Attenuator (20dB, 10W)	Aeroflex / Weinschel	23-20-34	3160	12	02-Aug-2018
ESA-E Series Spectrum Analyser	Agilent Technologies	E4402B	3348	12	20-Sep-2018
Power Supply	TTI	EL355R	4388	-	TU
0.92 to 2.2 GHz Coupler	Narda	3042B	4472	12	8-Dec-2017
Beacon Tester	WS Technologies	BT100S	3263	-	TU
Attenuator 10dB 10W	Weinschel	47-10-34	398	12	20-Oct-2017
Directional Coupler	Narda	3022	503	-	28-Nov-2017
Signal Generator (10MHz to 40GHz)	Rohde & Schwarz	SMR40	1002	12	14-Oct-2017
PXA Signal Analyser	Keysight Technologies	N9030A	4654	12	6-Oct-2017

TU – Traceability Unscheduled

OP MON – Output Monitored with Calibrated Equipment



Product Service

SECTION 4

PHOTOGRAPHS

4.1 PHOTOGRAPHS OF EQUIPMENT UNDER TEST (EUT)



EUT



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SECTION 5

DISCLAIMERS AND COPYRIGHT



Product Service

5.1 DISCLAIMERS AND COPYRIGHT

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Product Service

ANNEX A

MANUFACTURER SUPPLIED INFORMATION

MED-Z701 Exhibit 19 – Statement Regarding Beacon for GNSS Test

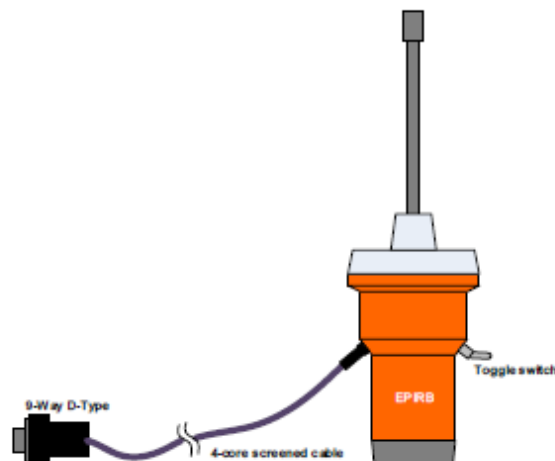
The beacon used for testing against IEC 61108-1 is GPS#1.

This beacon has been modified to allow direct access to the output of the GNSS module so that it could be monitored during testing.

The modification consists of a

- RS232 cable assembly (RS232 converter, connector and cable)
- Toggle switch cable assembly

The RS232 cable assembly translates the signals from the GNSS module into signals suitable for a PC input. The toggle switch is required to hold the microcontroller in reset to prevent it from communicating with the GNSS module during the test.



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