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Report On

GNSS testing of the
ACR Electronics Inc.
PLB-425

COMMERCIAL-IN-CONFIDENCE

Document 75943184 Report 07 Issue 1

March 2019



Product Service

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COMMERCIAL-IN-CONFIDENCE

REPORT ON

GNSS testing of the
ACR Electronics Inc.
PLB-425

Document 75943184 Report 07 Issue 1

March 2019

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DATED

06 March 2019





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SECTION 1

REPORT SUMMARY

GNSS testing of the
ACR Electronics Inc.
PLB-425



1.1 INTRODUCTION

The information contained in this report is intended to show verification of the ACR Electronics Inc. PLB-425 (PLB) to limited requirements of IEC 61108-1 as required by RTCM 11010.3 (clause 4.3.1.3.3).

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	ACR Electronics Inc.
Model Number(s)	PLB-425
Serial Number(s)	5 RTCM
Number of Samples Tested	1
Test Specification/Issue/Date	IEC 61108-1: 2003
Order Number	45752-00
Date	21 June 2018
Date of Receipt of EUT	04 July 2018
Start of Test	25 October 2018
Finish of Test	07 December 2018
Name of Engineer(s)	Theano Papakosta
Order Number	45752-00
Date	21 June 2018
Related Document(s)	GPS SPS Performance Specification - USA DoD - 3rd Edition October 2001 RTMC 11010.3



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1.2 BRIEF SUMMARY OF RESULTS

A brief summary of the tests carried out in accordance with IEC 61108-1 is shown below. These clauses are defined as required by the product specific standard and are defined in RTCM 11010.3 Clause 4.2.9.1.

Section	Spec Clause	Test Description	Result	Comments
2.1	5.6.4.1.1	Static Accuracy - GPS	Pass	
2.2	5.6.4.2	Static Accuracy - GPS - Angular Movement of the Antenna	Pass	
2.3	5.6.4.3.1	Dynamic Accuracy - GPS	Pass	
2.4	5.6.4.3.2	Dynamic Accuracy – Differential GPS	N/A	Not applicable – EUT does not support differential GPS
2.5	5.6.5.1	Acquisition - Condition A – Initialization	Pass	
2.5	5.6.5.2	Acquisition - Condition B - Power Outage	Pass	
2.6	5.6.5.3	Acquisition - Condition C - Interruption of GPS Signals	Pass	
2.7	5.6.5.4	Acquisition - Condition D – Brief Interruption of Power	Pass	
-	5.6.6	Short Circuit Protection	N/A	GPS antenna is located inside the EUT housing (handheld device)
2.8	5.6.8.1	Sensitivity and Dynamic Range - Acquisition	Pass	
2.9	5.6.8.2	Sensitivity and Dynamic Range - Tracking	Pass	
-	5.6.9	Effects of Interfering Signal	N/T	Refer to BSH report BSH/4542/001/41432 56/18
2.10	5.6.10.1	Slow Speed Update Rate	Pass	
2.11	5.6.10.2	High Speed Update Rate	Pass	

N/A Not Applicable
N/T Not Tested



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1.3 DECLARATION OF BUILD STATUS

MAIN EUT			
MANUFACTURING DESCRIPTION	Personal Locator Beacon (PLB)		
MANUFACTURER	ACR Electronics		
MODEL NAME/NUMBER	ResQLink™ & ResQLink™ View		
PART NUMBER	PLB-400 & PLB-425		
SERIAL NUMBER			
HARDWARE VERSION	T2		
SOFTWARE VERSION	A		
PSU VOLTAGE/FREQUENCY/CURRENT	9 Vdc/ 406.031 MHz and 121.5 MHz/42mA		
HIGHEST INTERNALLY GENERATED / USED FREQUENCY	406.031 MHz		
FCC ID (if applicable)	B66ACRPLB400425 (Not yet obtained)		
INDUSTRY CANADA ID (if applicable)	(Not yet obtained)		
TECHNICAL DESCRIPTION (a brief description of the intended use and operation)	PLB is a hand held unit to be activated in case of emergency when no other means of rescue are possible. Activation of the PLB sets in motion rescue services.		
COUNTRY OF ORIGIN	USA		
RF CHARACTERISTICS (if applicable)			
TRANSMITTER FREQUENCY OPERATING RANGE (MHz)	406.031 MHz and 121.5 MHz		
RECEIVER FREQUENCY OPERATING RANGE (MHz)	N/A		
INTERMEDIATE FREQUENCIES	N/A		
EMISSION DESIGNATOR(S): (i.e. G1D, GXW)	G1D (for 406.031 MHz) and A2A (for 121.5 MHz)		
MODULATION TYPES: (i.e. GMSK, QPSK)	GMDSS		
OUTPUT POWER (W or dBm)	5W (406.031 MHz) and 25mW (121.5 MHz)		
SEPARATE BATTERY/POWER SUPPLY (if applicable)			
MANUFACTURING DESCRIPTION			
MANUFACTURER			
TYPE			
PART NUMBER			
PSU VOLTAGE/FREQUENCY/CURRENT			
COUNTRY OF ORIGIN			
MODULES (if applicable)			
MANUFACTURING DESCRIPTION			
MANUFACTURER			
TYPE			
POWER			
FCC ID			
INDUSTRY CANADA ID			
EMISSION DESIGNATOR			
DHSS/FHSS/COMBINED OR OTHER			
COUNTRY OF ORIGIN			
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: Dan Stankovic

Position held: Director of Certification and Test

Date: 10/04/2018

1.4 PRODUCT INFORMATION

1.4.1 Technical Description

The Equipment Under Test (EUT) was an ACR Electronics Inc. PLB-425, 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

For all tests the EUT was set up in accordance with the relevant test standard and to represent typical operating conditions. Where simulated GNSS signals were applied the tests were carried out with the EUT situated in a shielded enclosure.

The NMEA data was recorded directly from the data cable connected to the device. The EUT was powered by the internal battery pack.

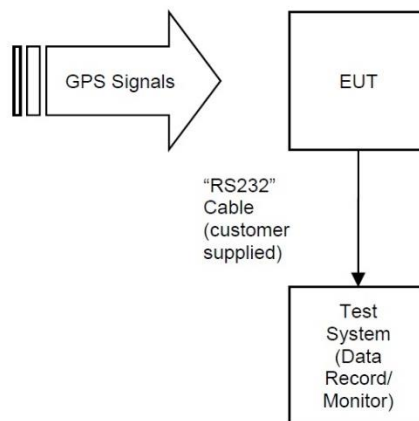


Figure 1. System Configuration A Schematic

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

The GPS signal applied is recorded at the appropriate test section.

Physical set up was defined by the standard for Static Accuracy (the Angular Movement of the antenna) tests. GPS signal input was as per "live" (real world) conditions at the time/location.

The physical configuration for the all the other tests was at most practical at the time. GPS signal input was checked using the reference receiver to provide enough of 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.

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



Product Service

1.5 TEST LOCATIONS

TUV SUD Product Service, Octagon House, Fareham.

1.6 DEVIATIONS FROM THE STANDARD

No deviations from the applicable test standards or test plan were made during testing.

1.7 MODIFICATION RECORD

No modifications were made to the EUT during testing.



Product Service

SECTION 2

TEST DETAILS

GNSS testing of the
ACR Electronics Inc.
PLB-425



Product Service

2.1 STATIC ACCURACY – GPS

2.1.1 Specification Reference

IEC 61108-1, Clause 5.6.4.1.1

2.1.2 Equipment Under Test

ACR Electronics Inc., PLB-425, S/N 5 RTCM, Modification State 0

2.1.3 Date of Test

30 October 2018 – 31 October 2018

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 11 – 13.5 °C
Relative Humidity 62.3 – 67.1%

2.1.6 Test Methods

The following testing is required by the specification:

Static Test Site Clause 5.5.2

“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 Set Up



Test Set up Photo

2.1.8 Test Results

EUT was placed on static test site with non-conductive platform. It was operated and monitored continuously for the period of measurements as given below.

Test Parameters	Units	Result	Limit
Test Specific			
Non-Conductive Platform Height	m	1.34	1-1.5
General			
Time to Acquire Valid Position	s	24.23	-
Performance Check			
Start Time / Event of Performance Check	-	Position Lock	-
Measurement Duration	hh:mm:ss	24:02:68	>24h
Total Number of Position Solutions	-	86553	-
Number of Solutions with HDOP≤4 and PDOP≤6	-	86553	-
Measurement of error ≤13m	%	99.94	>95



Product Service

2.2 STATIC ACCURACY – ANGULAR MOVEMENT OF THE ANTENNA

2.2.1 Specification Reference

IEC61108-1, Clause 5.6.4.2

2.2.2 Equipment Under Test

ACR Electronics Inc., PLB-425, S/N 5 RTCM, Modification State 0

2.2.3 Date of Test

06 November 2018 to 07 November 2018

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 10.8 – 13.0
Relative Humidity 58.0 – 72.1%

2.2.6 Test Methods

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 Set Up



Test Set Up

2.2.8 Test Results

EUT was placed on static test site on a non-conductive platform. It was operated and monitored continuously for the period of measurement as given below.

Test Parameters	Units	Result	Limit
Test Specific			
Non-Conductive Platform Height	m	1.34	1-1.5
General			
Time to Acquire Valid Position	s	29.01	-
Performance Check			
Start Time / Event of Performance Check	-	Position Lock	-
Measurement Duration	hh:mm:ss	24:09:63	>24h
Total Number of Position Solutions	-	87989	-
Number of Solutions with HDOP≤4 and PDOP≤6	-	87989	-
Measurement of error ≤13m	%	99.67	>95



Product Service

2.3 DYNAMIC ACCURACY – GPS

2.3.1 Specification Reference

IEC 61108-1, Clause 5.6.4.3.1

2.3.2 Equipment Under Test

ACR Electronics Inc., PLB-425, S/N 5 RTCM, Modification State 0

2.3.3 Date of Test

25 October 2018

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 23.7°C
Relative Humidity 43%

2.3.6 Test Method

The following testing is required by the specification:

IEC-61108:2003 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, shall not indicate a positional offset $>\pm 13$ m from the final position 10 s after coming to rest;

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 shall remain in lock and follow the actual position to within a lane of 30 m wide centred on the mean direction of motion.”

2.3.7 Test Set Up



Test Set Up



2.3.8 Test Results

Dynamic Accuracy A

EUT and GPS simulator were started simultaneously. The EUT acquired position lock after the acquisition time stated 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. The position output 10 seconds after coming to rest was determined by NMEA 0183 output.

Test Parameters	Units	Result	Limit
General			
Signal Type	Live / Simulated	Simulated	-
EUT Started Simultaneously	Y/N	Y	-
Time to Acquire Valid position	s	18.8	-
Test Specific			
Position Error 10s after coming to rest	m	0.41	≤13
Performance Specific			
Start Time / Event of performance check	-	10 s After performance comes to rest	-
Total Number of Position solutions	-	601	-
Number of solution with HDOP ≤4 and PDOP ≤6	-	600	-
Measurement Duration	Min	10	-
Measurement of error ≤13m	%	100	-



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Dynamic Accuracy B

EUT and GPS simulator were started simultaneously, the EUT acquired the 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 $\pm 2\text{m}$ either side of the original path for further 20 minutes.

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

A Performance Check was conducted during the 20-minute oscillation period in order to determine that the position error was not outside of the $\pm 15\text{ m}$ 'lane' of tolerance.

Test Parameters	Units	Result	Limit
General			
Signal Type	Live / Simulated	Simulated	-
EUT Started Simultaneously	Y/N	Y	-
Initial Acquisition Time	s	35.2	-
Performance Check	P/F	P	P
Start Time / Event of performance check	-	Start of Oscillation	-
Total Number of Measurement	-	601	-
Number of solution with HDOP ≤ 4 and PDOP ≤ 6	-	601	≥ 100
Measurement Duration	Min	10	> 2
Measurement of error $\leq 15\text{m}$	%	100	100



Product Service

2.4 DYNAMIC ACCURACY – DIFFERENTIAL GPS

2.4.1 Specification Reference

IEC 61108-1, Clause 5.6.4.3.2

Not applicable – EUT does not support differential GPS.



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2.5 ACQUISITION CONDITION A - INITIALIZATION

2.5.1 Specification Reference

IEC 61108-1, Clause 5.6.5.1

2.5.2 Equipment Under Test

ACR Electronics Inc., PLB-425, S/N 5 RTCM, Modification State 0

2.5.3 Date of Test

26 November 2018

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 23.6 °C

Relative Humidity 42.9%

2.5.6 Test Methods

The following testing is required by the specification:

Test Method Clause 5.6.5.1

"The EUT shall be either:

- a) Initialised to a false position at least 1000 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."

2.5.7 Test Set Up



Test Set Up

2.5.8 Test Results

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

Time to lock was measured and a performance test was started once the position lock was obtained. The simulator ran as static position for a sufficient time for the remaining test to complete.

Test Parameter	Units	Results	Limit
Test Specific			
False position difference from test position	km	1679.28	1000-10000
Time to acquire valid position	s	01.43	<30 min
Performance Check			
Start time / event	-	Position Lock	-
Measurement duration	Min	10	$5 \leq$ and ≥ 10
Total number of position solutions	-	601	-
Number of solutions with HDOP ≤ 4 and PDOP ≤ 6	-	601	≥ 100
Measurement with position error $\leq 13m$	%	100	≥ 95



Product Service

2.6 ACQUISITION CONDITION B – POWER OUTAGE

2.6.1 Specification Reference

IEC 61108-1, Clause 5.6.5.2

2.6.2 Equipment Under Test

ACR Electronics Inc., PLB-425, S/N 5 RTCM, Modification State 0

2.6.3 Date of Test

21 November 2018 – 22 November 2018

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 22.5 – 23.4 °C
Relative Humidity 42.6 – 44.7 %

2.6.6 Test Methods

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 no valid almanac data.”

2.6.7 Test Set Up



Test Set Up

2.6.8 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	Results	Limit
Test Specific			
Power isolation period	hh:mm:ss	24:08:22	≥ 24 and ≤ 25
Time to acquire valid position	s	26	<5 min
Performance Check			
Start time / event	-	Position Lock	-
Measurement duration	Min	10	$5 \leq$ and ≥ 10
Total number of position solutions	-	601	-
Number of solutions with HDOP ≤ 4 and PDOP ≤ 6	-	601	≥ 100
Measurement with position error ≤ 13 m	%	100	≥ 95



Product Service

2.7 ACQUISITION CONDITION C – INTERRUPTION OF GPS SIGNAL

2.7.1 Specification Reference

IEC 61108-1, Clause 5.6.5.3

2.7.2 Equipment Under Test

ACR Electronics Inc., PLB-425, S/N 5 RTCM, Modification State 01

2.7.3 Date of Test

06 December 2018 – 07 December 2018

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 22.0 °C
Relative Humidity 43.6%

2.7.6 Test Methods

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.”

2.7.7 Test Set Up



Test Set Up

2.7.8 Test Results

EUT was position locked and stable when the GPS signal was removed for an isolation period. Upon application of GPS the re-acquisition time was measured, and a performance check was performed.

Test Parameter	Units	Results	Limit
Test Specific			
Power isolation period	hh:mm:ss	24:22:06	$24 \leq$ and ≥ 25
Time to acquire valid position	s	48	<5 min
Performance Check			
Start time / event	-	Re-acquisition	-
Measurement duration	Min	10	$5 \leq$ and ≥ 10
Total number of position solutions	-	591	-
Number of solutions with HDOP $\leq$ 4 and PDOP $\leq$ 6	-	591	≥ 100
Measurement with position error $\leq$ 13m	%	100	≥ 95



Product Service

2.8 ACQUISITION CONDITION D – BRIEF INTERRUPTION OF POWER

2.8.1 Specification Reference

IEC 61108-1, Clause 5.6.5.4

2.8.2 Equipment Under Test

ACR Electronics Inc., PLB-425, S/N 5 RTCM, Modification State 1

2.8.3 Date of Test

26 October 2018

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 24.7 °C
Relative Humidity 42.8%

2.8.6 Test Methods

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/A3.10) 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.”

2.8.7 Test Set Up



Test Set Up

2.8.8 Test Results

EUT was position locked and stable when the GPS signal was removed for an isolation period. Upon application of power the re-acquisition time was measured, and a performance check was performed.

Test Parameter	Units	Results	Limit
Test Specific			
Power isolation period	s	62.9	About 60s
Time to acquire valid position	s	25.5	<2 min
Performance Check			
Start time / event	-	Re-acquisition	-
Measurement duration	Min	10	5 ≤ and ≥ 10
Total number of position solutions	-	601	-
Number of solutions with HDOP≤4 and PDOP≤6	-	601	≥100
Measurement with position error ≤ 13m	%	100	≥95



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2.9 SHORT CIRCUIT PROTECTION

2.9.1 Specification Reference

IEC 61108-1, Clause 5.6.6

No antenna input is provided (GPS antenna is located inside the EUT housing (handheld device)).



Product Service

2.10 SENSITIVITY AND DYNAMIC RANGE - ACQUISITION

2.10.1 Specification Reference

IEC 61108-1, Clause 5.6.8.1

2.10.2 Equipment Under Test

ACR Electronics Inc., PLB-425, S/N 5 RTCM, Modification State 1

2.10.3 Date of Test

26 October 2018

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 21.1°C
Relative Humidity 45%

2.10.6 Test Methods

The following testing is required by the specification:

Test Clause 5.6.8.1

“This is tested by using a simulator

- a) Transmit the simulator signal over a suitable antenna.
- b) Adjust the signal power by use of a calibrated test receiver to -125 dBm $\pm$ 5 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

Required result

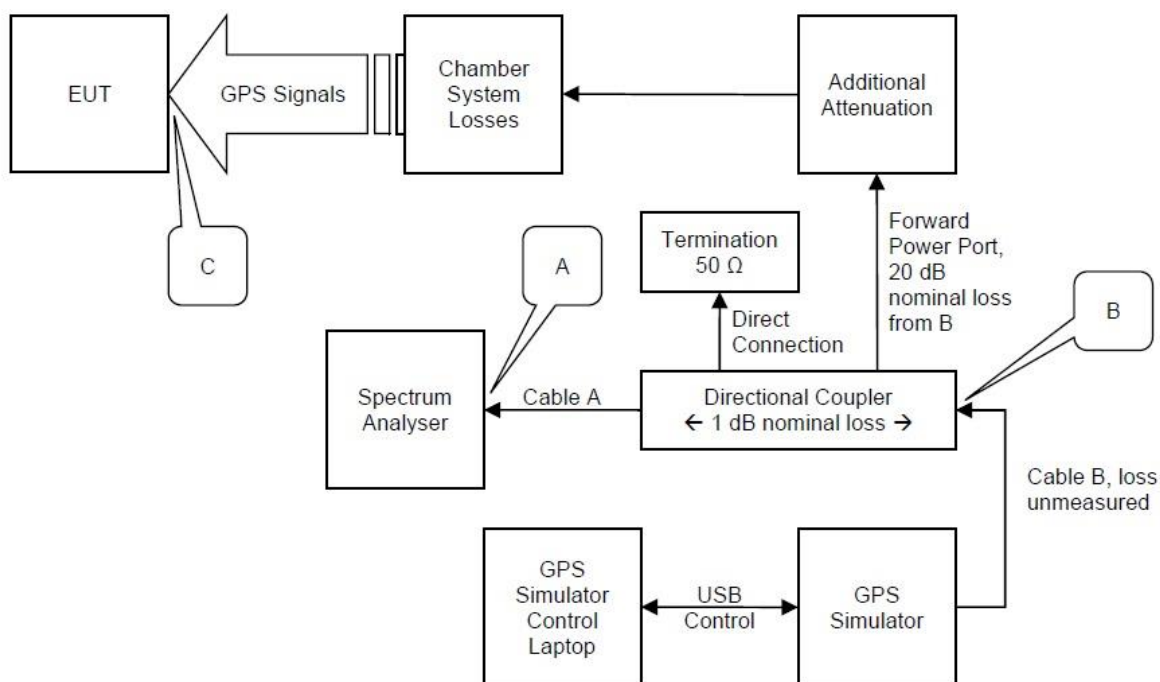
“The EUT shall meet the requirements of this check, within this signal range.”

2.10.7 Test Set Up



Test Set Up

Calibrated Field Set Up:



The basic premise of field schematic is that the power at C equals power at B minus loss from B to C. Power at B equals power at A minus loss from B to A.



Product Service

2.10.8 Test Results

EUT was activated in the above test setup, acquisition time was measured, and the performance check was carried out.

Test Parameter	Units	Results	Limit
Test Specific			
Received signal strength	dBm	-124.16	-125 ±5
General			
Initial Acquisition time	s	99	-
Performance check			
Start time / event	-	Position lock	-
Measurement duration	Min	10	5 ≤ and ≥ 10
Total Number of measurements	-	601	-
Number of solution with HDOP ≤4 and PDOP ≤6	-	600	≥100
Measurement with position error ≤ 13 m	%	99.5	≥95



Product Service

2.11 SENSITIVITY AND DYNAMIC RANGE – TRACKING

2.11.1 Specification Reference

IEC 61108-1, Clause 5.6.8.2

2.11.2 Equipment Under Test

ACR Electronics Inc., PLB-425, S/N 5 RTCM, Modification State 0

2.11.3 Date of Test

26 October 2018

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 45%

2.11.6 Test Methods

The following testing is required by the specification:

Test Clause 5.6.8.2

“The received satellite signals shall be monitored by a suitable test receiver. These signals shall be attenuated down to –133 dBm. Under these conditions, the performance requirements shall be met.

This is tested by using a simulator. Method:

- a) Transmit the simulator signal over a suitable antenna.
- b) Adjust the signal power by use of a calibrated test receiver to –125 dBm ± 5 dBm.
- c) Replace the antenna of the calibrated test receiver by the receiving unit of the EUT.
- d) After the start of transmission and tracking with the nominal transmission level condition,
gradually reduce transmission level down to –133 dBm.

Required Result

“The EUT shall continue tracking at least one satellite.”



Product Service

2.11.7 Test Set Up

The initial test set up is identical to “Sensitivity and Dynamic Range – Acquisition”.

2.11.8 Test Results

EUT remained operational after “Sensitivity and Dynamic Range – Acquisition”, locked and settled having just completed the performance check. Signal power was then reduced gradually.

Test Parameter	Units	Results	Limit
Test Specific			
Received signal strength (per SV) - initial	dBm	-124.16	-125 ±5
Received signal strength (per SV) - final	dBm	-133.58	-133
Reduction increment	dB	2	See Note 1
Total duration of reduction and measurement	Min	10	See Note 1
Satellite in Scenario	-	11	-
Required EUT Response			
Satellites Tracked	-	10	≥ 1

NOTE 1: The received signal strength was gradually reduced by 10 dB in no more than 2 dB steps over a period of approximately 10 minutes. A received signal strength less than the requirement in the table above was considered an over-test.



Product Service

2.12 EFFECTS OF INTERFERRING SIGNALS

2.12.1 Specification Reference

IEC 61108-1, Clause 5.6.9

Refer to BSH Report: BSH/4542/001/4143256/18



Product Service

2.13 POSITION UPDATE – SLOW SPEED UPDATE RATE

2.13.1 Specification Reference

IEC 61108-1, Clause 5.6.10.1

2.13.2 Equipment Under Test

ACR Electronics Inc., PLB-425, S/N 5 RTCM, Modification State 0

2.13.3 Date of Test

25 October 2018

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 23.1°C
Relative Humidity 52.8%

2.13.6 Test Methods

The following testing is required by the specification:

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.

Performance standard clause 5.6.10.2

“[...] 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.”

2.13.7 Test Set Up



Test Set Up



2.13.8 Test Results

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

Test Parameters	Units	Result	Limit
General			
Time to Acquire Valid Position	s	36.16	-
Test Specific			
Scenario Velocity	Knots	4.86	-
Minimum Position Change (Min[dLat+dLon])*	Decimal Degrees	0	>0
Maximum Position Update Interval	s	1.060	≤10
Sample Latitude Field Value	DDMM.X	5051.01729	Resolution must be to 0.001
Sample Longitude Field Value	DDMM.X	00108.61717	Resolution must be to 0.001
Performance Check			
Start Time / Event of Performance Check	-	Start of steady velocity	-
Measurement duration	Min	10	10
Total number of position solutions	-	601	-
Number of Solutions with HDOP ≤4 and PDOP ≤6	-	600	≥100
Measurement of error ≤13m	%	100	≥95

*Note: If the minimum position change was zero, it would indicate that the position output was not updated; hence any result above zero would indicate that the output was updated.



Product Service

2.14 POSITION UPDATE – HIGH SPEED UPDATE RATE

2.14.1 Specification Reference

IEC 61108-1, Clause 5.6.10.2

2.14.2 Equipment Under Test

ACR Electronics Inc., PLB-425, S/N 5 RTCM, Modification State 0

2.14.3 Date of Test

25 October 2018

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 22.5 °C
Relative Humidity 43.4 %

2.14.6 Test Methods

The following testing is required by the specification:

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 5.6.10.1

“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.”

Performance standard clause 5.6.10.2

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

2.14.7 Test Set Up



Test Set Up

2.14.8 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.

Test Parameters	Units	Result	Limit
General			
Time to Acquire Valid Position	s	63	-
Test Specific			
Scenario Velocity	Knots	70	-
Minimum Position Change (Min[dLat+dLon])	Decimal Degrees	0.000511	>0
Maximum Position Update Interval	s	1.010	≤10
Sample Latitude Field Value	DDMM.X	5052.99624	Resolution must be to 0.001
Sample Longitude Field Value	DDMM.X	00101.23363	Resolution must be to 0.001
Performance Check			
Start Time / Event of Performance Check	-	Start of steady velocity	-
Measurement duration	Min	10	10



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Total number of position solutions	-	600	-
Number of Solutions with HDOP ≤ 4 and PDOP ≤ 6	-	600	≥ 100
Measurement of error $\leq 13\text{m}$	%	100	≥ 95



Product Service

SECTION 3

TEST EQUIPMENT USED



Product Service

3.1 TEST EQUIPMENT USED

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

Instrument	Manufacturer	TE No.	Calibration Date	Calibration due
Digital Hygrometer	Rotronic	1388	20-Jun-2018	20-Jun-2019
GNSS Simulator	Spirent	3056	06-Oct-2018	06-Oct-2019
Spectrum Analyser	Agilent Technologies	3348	25-Sep-2018	25-Sep-2019
50 Ohm Load	Meca	0362	09-May-2018	09-May-2019
Antenna	EMCO	0795	09-Oct-2018	09-Oct-2019
Directional Coupler	Narda	0503	-	O/P Mon
Attenuator	Weinschel	0481	-	O/P Mon
Cable	Reynolds	2402	-	O/P Mon
Cable	Rosenberger	5029	-	O/P Mon
Cable	Rosenberger	5027	-	O/P Mon
Network Analyser	Agilent Technologies	3348	25-Sep-2018	25-Sep-2019
Calibration Kit	Rohde & Schwarz	4368	22-Oct-2018	22-Oct-2019
Stop Watch	RS Components	2674	25-Jul-2018	25-Jul-2018

O/P Mon – Output Monitored using Calibrated Equipment



Product Service

SECTION 4

PHOTOGRAPHS

4.1 PHOTOGRAPHS OF EQUIPMENT UNDER TEST (EUT)



EUT (with antenna stowed)



Product Service

SECTION 5

ACCREDITATION, DISCLAIMERS AND COPYRIGHT



Product Service

5.1 ACCREDITATION, DISCLAIMERS AND COPYRIGHT



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