Excellence in Compliance Testing

5015 B. U. Bowman Dr.
Buford, GA 30518

Wednesday, May 06, 2015

Johnson Outdoors Marine Electronics, Inc.:
678 Humminbird Lane
Eufaula, AL 36027
USA

Tambryn Freund:
(770) 888-6292 x1049
Tfreund@johnsonoutdoors.com

Our investigation of the Helix 7 has concluded. The results of the investigation is listed below and is documented by report number 15-0004.

Customer requested tests from the following test standard(s) and/or specification(s):

Report number	Test Requirements	Results
15-0004.C08.1B	Electromagnetic Compatibility Directive – 2004/108/EC	PASSED
15-0004.C09.3B	Radio & Telecommunications Terminal Equipment (R&TTE) Directive – 99/55/EC	PASSED
15-0004.C14.2B	EN 60945:2002, Section 11.2 Compass Safe Distance	PASSED
15-0004.W09.1A	EN 300 440-2 V1.4.1	PASSED
15-0004.S11.1B	EN 60950-1:2006 Clauses: 4.5.4 Touch Temperature Limits 5.1 Touch Current 5.2 Electric Strength	PASSED

Testing was concluded on January 7, 2015 at our facility in Buford, GA.

This letter accompanies the test reports for this product and any other supporting documentation of the testing performed.

Kind Regards,

Forrest Duncan

Forrest Duncan
EMC Department Manager
Advanced Compliance Solutions, Inc.

For The Scope of Accreditation Under Lab Code 200612-0

Excellence in Compliance Testing

EMC Technical Report

Prepared For: Johnson Outdoors Marine Electronics

Model Covered: Helix 7 SI GPS
Model Variants: See Appendix A

In Accordance with the:
Electromagnetic Compatibility Directive – 2004/108/EC

Immunity Product Standard: EN 60945:2002
Emissions Product Standard(s):
EN 60945:2002

ACS Report: 15-0004.C08.1B
Report Revision: B
Report Issue Date: May 6, 2015

Project Manager:

Sean Vick
EMC Technician
Advanced Compliance Solutions, Inc.

Reviewed by:

Forrest Duncan
EMC Department Manager
Advanced Compliance Solutions, Inc.

This report must not be used by the client to claim product certification, approval, or endorsement by NVLAP, NIST, or any agency of the Federal Government.

This report contains 44 pages

REVISION HISTORY Report Number: 15-0004.C08.1B Manufacturer: Johnson Outdoors Marine Electronics Model: Helix 7 SI GPS					
DATE	OLD REVISION	NEW REVISION	REASON	PAGES AFFECTED	APPROVED BY
February 6, 2015	---	A	Initial Release	All	Forrest Duncan
May 6, 2015	A	B	Revised Radiated Emissions test data; Revised model variants	17, 44	Forrest Duncan

Project Information Sheet

ACS Project: 15-0004.C08.1B

Applicant Details

Manufacturer: Johnson Outdoors Marine Electronics
Street Address: 678 Humminbird Ln
City, State/Province and Postal Code: Eufaula, AL 36027
Country: USA
Contact: Tambryn Freund

Phone:
Fax:
Email: Tambryn.Freund@johnsonoutdoors.com

Sample Information

Model: Helix 7 SI GPS
Model Variant(s): See Appendix A
Environment of Use: Residential; Mounted on the main deck/consoles of small recreational vessels in an exposed environment.
Sample Receive Date: January 5, 2015
Sample Receive Condition: Good
Test Mode Description: GPS active, transducer active
Failure Mode (Provided by Mfg.): If the device fails to recover (i.e. GPS/Sonar Operation) upon reboot
Highest Data Rate: 266MHz
Source: Microcontroller

Product Description

The HUMMINBIRD Helix 7 SI GPS is a fishfinder/GPS product with Side Imagine sonar capability to be used in the marine environment. It is comprised of a keyboard, LCD display, micro SD card slot, Internal GPS, transducer and power cable.

Test Information

Test Start Date: January 5, 2015
Test End Date: January 7, 2015
Emissions Pre-scan Site: SAC
Final Emissions Site: SAC
EMI Freq. Band: 10kHz to 2GHz
RFI Site: FAC
Radiated Emissions Equipment Class: Class B
Harmonic Current EMI Class: N/A

Test Methods Applied

(Check all that apply)

- ☒ CISPR 16-2-1 Ed. 1.1 2005
- ☒ CISPR 16-2-3 1st Ed. 2003
- ☒ IEC 61000-4-2 Ed. 2.0
- ☒ IEC 61000-4-3 Ed. 3.2
- ☒ IEC 61000-4-4 Ed. 3.0
- ☐ IEC 61000-4-5 2nd Ed.
- ☒ IEC 61000-4-6 3rd Ed.
- ☐ IEC 61000-4-8 2nd Ed.
- ☐ IEC 61000-4-11 2nd Ed.

Table of Contents

SECTION A: GENERAL INFORMATION

1.0 Introduction

1.1 Scope

This report documents conformance with the requirements set forth in EN 60945:2002 and details the results of testing performed on January 5, 2015 through January 7, 2015 on the model Helix 7 SI GPS manufactured by Johnson Outdoors Marine Electronics.

1.2 Purpose

Testing was performed to evaluate the EUT with regard to EMC regulatory requirements in accordance with the European Unions CE Marking arrangements.

1.3 Results Summary

Product Standard or Test Method Applied	Description	Result
	Product Standards	
EN 60945:2002	Maritime navigation and radio communication equipment and systems General Requirements Methods of testing and required test results	Pass
EN 61000-3-2:2006 w/A1:2009 and A2:2009	Electromagnetic compatibility (EMC) -- Part 3-2: Limits - Limits for harmonic current emissions (equipment input current <= 16 A per phase)	N/A
EN 61000-3-3:2008	Electromagnetic compatibility (EMC) - Part 3-3: Limits - Limitation of voltage changes, voltage fluctuations and flicker in public low-voltage supply systems, for equipment with rated current <= 16 A per phase and not subject to conditional connection	N/A
	Basic Immunity Standards per EN 60945:2002	
IEC 61000-4-2 Ed. 2.0	Electromagnetic compatibility (EMC) - Part 4-2: Testing and measurement techniques - Electrostatic discharge immunity test	Pass
IEC 61000-4-3 Ed. 3.2	Electromagnetic compatibility (EMC) - Part 4-3: Testing and measurement techniques - Radiated, radio-frequency, electromagnetic field immunity test	Pass
IEC 61000-4-4 Ed. 3.0	Electromagnetic compatibility (EMC) - Part 4-4: Testing and measurement techniques - Electrical fast transient/burst immunity test	Pass
IEC 61000-4-5 2nd Ed.	Electromagnetic compatibility (EMC) - Part 4-5: Testing and measurement techniques - Surge immunity test	N/A
IEC 61000-4-6 3rd Ed.	Electromagnetic compatibility (EMC) - Part 4-6: Testing and measurement techniques - Immunity to conducted disturbances, induced by radio-frequency fields	Pass
IEC 61000-4-8 2nd Ed.	Electromagnetic compatibility (EMC) - Part 4-8: Testing and measurement techniques - Power frequency magnetic field immunity test	N/A
IEC 61000-4-11 2nd Ed.	Electromagnetic compatibility (EMC) - Part 4-11: Testing and measurement techniques - Voltage dips, short interruptions and voltage variations immunity tests	N/A

N/A = Not Applicable

1.4 Performance Criteria

1.4.1 Emissions Performance Criteria

For model Helix 7 SI GPS the limits which apply are EN 60945:2002 Class B. These limits are found in Table 1.4.1-1 below:

Table 1.4.1-1 Emissions Limits EN 60945:2002 Class B

	Portable	Protected	Exposed	Submerged
Conducted emissions (9.2)		10 kHz – 150 kHz 150 kHz – 350 kHz 350 kHz – 30 MHz	63 mV – 0,3 mV (96 dBµV – 50 dBµV) 1 mV – 0,3 mV (60 dBµV – 50 dBµV) 0,3 mV (50 dBµV)	
Radiated emissions (9.3)	150 kHz – 300 kHz 300 kHz – 30 MHz 30 MHz – 2 GHz 156 MHz – 165 MHz	10 mV/m – 316 µV/m (80 dBµV/m – 52 dBµV/m) 316 µV/m – 50µV/m (52 dBµV/m – 34 dBµV/m) 500 µV/m (54 dBµV/m) except for 16 µV/m (24 dBµV/m) quasi-peak or 32 µV/m (30 dBµV/m) peak		

1.4.2 Immunity Performance Criteria

Each immunity test requires 1 of 3 performance criteria to be met. Below are descriptions of each.

Performance Criterion A: The EUT shall continue to operate as intended during and after the test. No degradation of performance or loss of function is allowed, as defined in the relevant equipment standard and in the technical specification published by the manufacturer.

Performance Criterion B: The EUT shall continue to operate as intended after the test. No degradation of performance or loss of function is allowed, as defined in the relevant equipment standard and in the technical specification published by the manufacturer. During the test, degradation or loss of function or performance which is self-recoverable is however, allowed, but no change of actual operating state or stored data is allowed.

Performance Criterion C: Temporary degradation or loss of function or performance is allowed during the test, provided the function is self-recoverable, or can be restored at the end of the test by the operation of the controls, as defined in the relevant equipment standard and in the technical specification published by the manufacturer.

2.0 Test Facilities & Environment

2.1 Test Facilities
All testing was performed at the following address:

Advanced Compliance Solutions, Inc.
5015 B.U. Bowman Drive
Buford GA 30518
Phone: (770) 831-8048
Fax: (770) 831-8598
www.acstestlab.com

The laboratory is fully equipped to carry out the tests outlined in section 1.0

2.2 Laboratory Accreditations/Recognitions/Certifications
ACS is accredited to ISO/IEC 17025 by the National Institute of Standards and Technology under their National Voluntary Laboratory Accreditation Program (NVLAP). Unless otherwise specified, all tests methods described within this report are covered under the ISO/IEC 17025 scope of accreditation.

2.3 Test Environment
Unless otherwise specified by the generic or product standard, the EUT was evaluated within the climate conditions of the EUT as specified by the manufacturer.

Where the manufacturer does not specify climate parameters for the EUT, all test are performed within the climate parameters given below:

- Ambient temperature 15° to 35° C
- Relative Humidity 30% to 60%
- Atmospheric Pressure 860mbar to 1060mbar

2.4 Test Equipment Calibration Statement
Test equipment used for each test is specified in the relevant sections of this test report. Unless expressly given, all test equipment is calibrated on an annual basis, where applicable. All test equipment is operated within the climate specifications as defined by the manufacturer.

3.0 Equipment Under Test (EUT)

3.1 Manufacturer
Johnson Outdoors Marine Electronics
678 Humminbird Ln
Eufaula, AL 36027
Tambryn Freund
Tambryn.Freund@johnsonoutdoors.com

3.2 Modifications

Table 3.2-1 below describes any modification required to bring the EUT into compliance with the test standard. Photographs of the modifications, if any, are contained in appendix a.

Table 3.2-1: EUT Modifications

☒ **Modifications were not required to bring the EUT into compliance with the requirements.** ☐ **Modifications were required to bring the EUT into compliance with the requirements.**

3.3 System Block Diagram and Support Equipment

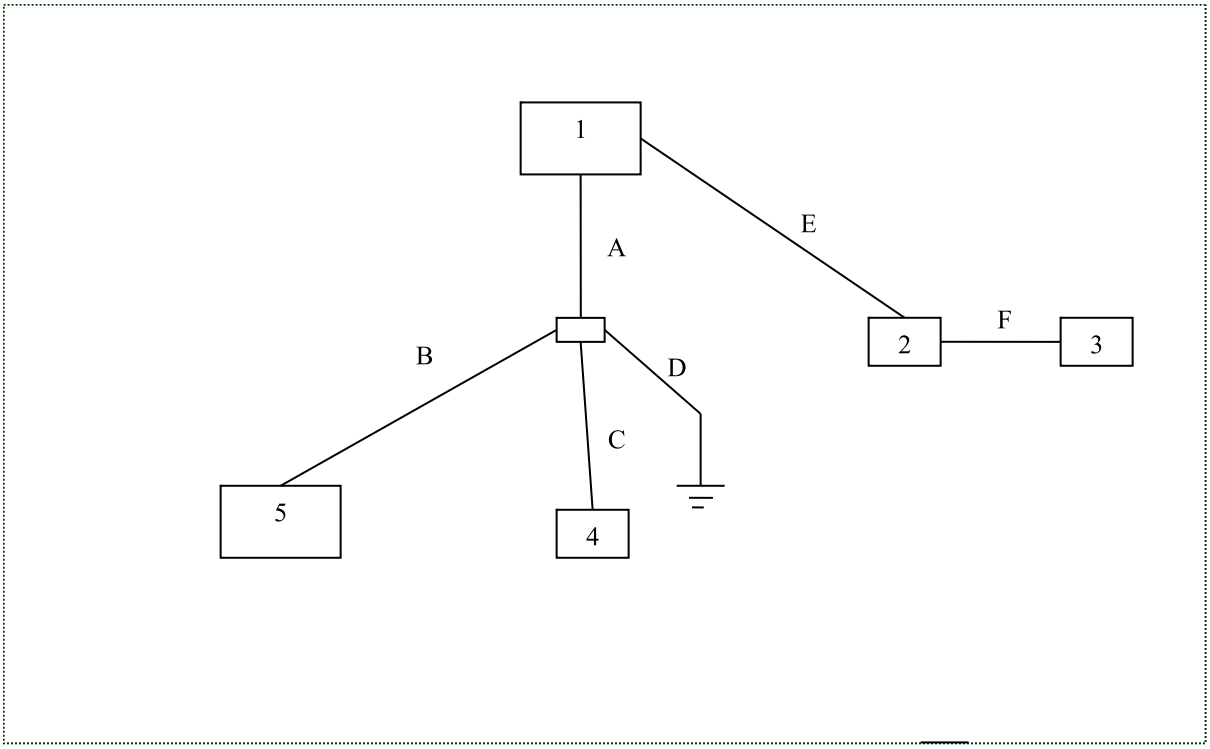


Figure 3.3-1: System Block Diagram

Table 3.3-1: EUT and Support Equipment Description

Item #	Type Device	Manufacturer	Model/Part #	Serial #
1	EUT	Johnson Outdoors	Helix 7 SI GPS	14121724-0001
2	Transducer	Johnson Outdoors	N/A	N/A
3	Depth Simulator	Johnson Outdoors	N/A	N/A
4	GPS Antenna	Humminbird	AS GR50 GPS module	10102742-0165
5	12Vdc Battery	AUTOCRAFT	M24-1	N/A

Table 3.3-2: Cable Description

Cable #	Cable Type	Length	Shield	Termination
A	Signal cable	1m	No	1 - junction
B	Power cable	1.8m	No	5 - junction
C	Signal cable	6m	No	4 - junction
D	Ground braid	1m	No	Junction - ground
E	Transducer cable	6m	No	1 - 2
F	Transducer cable	1m	No	2 - 3

3.4 Observations

Any general observations regarding any part of the evaluation are given in table 3.4-1.

Table 3.4-1: Observations

Observation No.	Description

SECTION B: EMISSIONS – TEST INFORMATION AND RESULTS

4.0 Radiated and Conducted Emissions

4.1 Radiated Emissions

4.1.1 Test Site Description

4.1.1.1 Open Area Test Site

The open area test site consists of a 40’ x 66’ concrete pad covered with a perforated electro-plated galvanized sheet metal. The perforations in the sheet metal are 1/8” holes that are staggered every 3/16”. The individual sheets are placed to overlap each other by 1/4” and are riveted together to provide a continuous seam. Rivets are spaced every 3” in a 3 x 20 meter perimeter around the antenna mast and EUT area. Rivets in the remaining area are spaced as necessary to properly secure the ground plane and maintain the electrical continuity.

The entire ground plane extends 12’ beyond the turntable edge and 16’ beyond the antenna mast when set to a 10 meter measurement distance. The ground plane is grounded via 4 - 8’ copper ground rods, each installed at a corner of the ground plane and bound to the ground plane using 3/4" stainless steel braided cable.

The turntable is an all aluminum 10’ flush mounted table installed in an all aluminum frame. The table is remotely operated from inside the control room located 40’ from the range. The turntable is electrically bonded to the surrounding ground plane via steel fingers installed on the edge of the turn table. The steel fingers make constant contact with the ground plane during operation.

Adjacent to the turntable is a 7’ x 7’ square and 4’ deep concrete pit used for support equipment if necessary. The pit is equipped with 5 - 4” PVC chases from the pit to the control room that allow for cabling to the EUT if necessary. The underside of the turntable can be accessed from the pit so cables can be supplied to the EUT from the pit. The pit is covered with 2 sheets of 1/4" diamond style re-enforced steel sheets. The sheets are painted to match the perforated steel ground plane; however the underside edges have been masked off to maintain the electrical continuity of the ground plane. All reflecting objects are located outside of the ellipse defined in ANSI C63.4.

A diagram of the Open Area Test Site is shown in Figure 4.1.1.1-1 below:

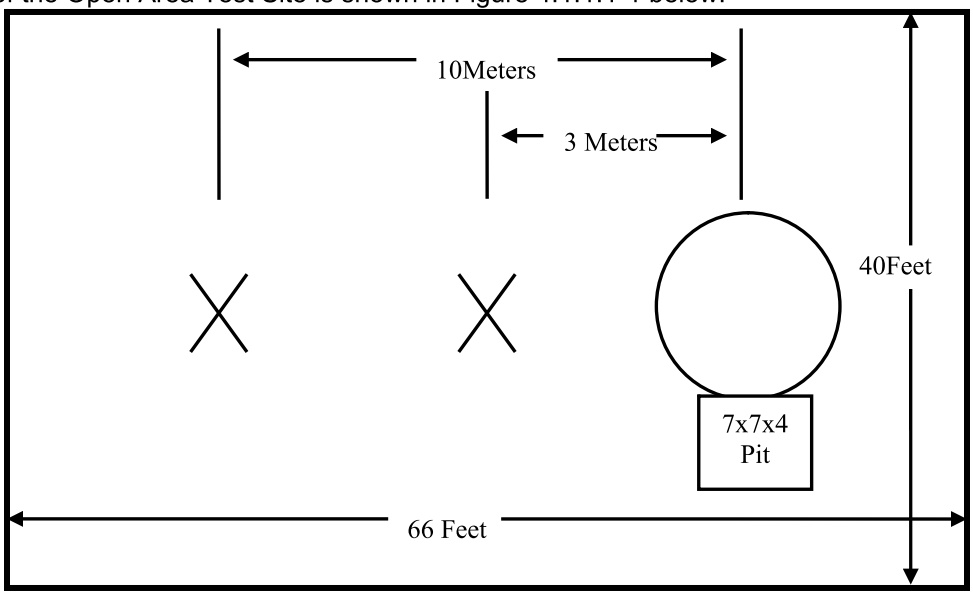


Figure 4.1.1.1-1: Open Area Test Site

4.1.1.2 Semi-Anechoic Chamber

The Semi-Anechoic Chamber Test Site consists of a 20' x 30' x 18' shielded enclosure. The chamber is lined with Toyo Ferrite Grid Absorber, model number FFG-1000. The ferrite tile grid is 4" x 4" x ¾" thick and weighs approximately 1.4lbs. These tiles are mounted on steel panels and installed directly on the inner walls of the chamber.

The turntable is 150cm in diameter and is located 160cm from the back wall of the chamber. The chamber is grounded via 1 - 8' copper ground rod, installed at the center of the back wall, it is bound to the ground plane using 3/4" stainless steel braided cable. The turntable is all steel, flush mounted table installed in an all steel frame. The table is remotely operated from inside the control room located 25' from the turntable. The turntable is electrically bonded to the surrounding ground plane via steel fingers installed on the edge of the turn table. The steel fingers make constant contact with the ground plane during operation.

Behind the turntable is a 3' x 6' x 4' deep shielded pit used for support equipment if necessary. The pit is equipped with 1 - 4" PVC chase from the turntable to the pit that allow for cabling to the EUT if necessary. The underside of the turntable can be accessed from the pit so cables can be supplied to the EUT from the pit.

To comply with the requirements of the test methods given on page 3, RF absorbing foam was placed inside the chamber in a configuration that provided the best results. First, an 8 ft. patch of 12" tall absorber was placed on the floor between the turntable and the receiving antenna. This absorber meets the absorption requirements specified in ANSI C63.4:2009. Next, three vertical structures (Fences) were created and covered with 8" pyramidal RF absorbing foam, two 4 ft. x 4 ft. and one 6 ft. x 4 ft. These fences were placed at locations to prevent high energy signals from reaching the back chamber wall and reflecting back to the receive antenna.

A diagram of the Semi-Anechoic Chamber Test Site is shown in Figure 4.1.1.2-1 below:

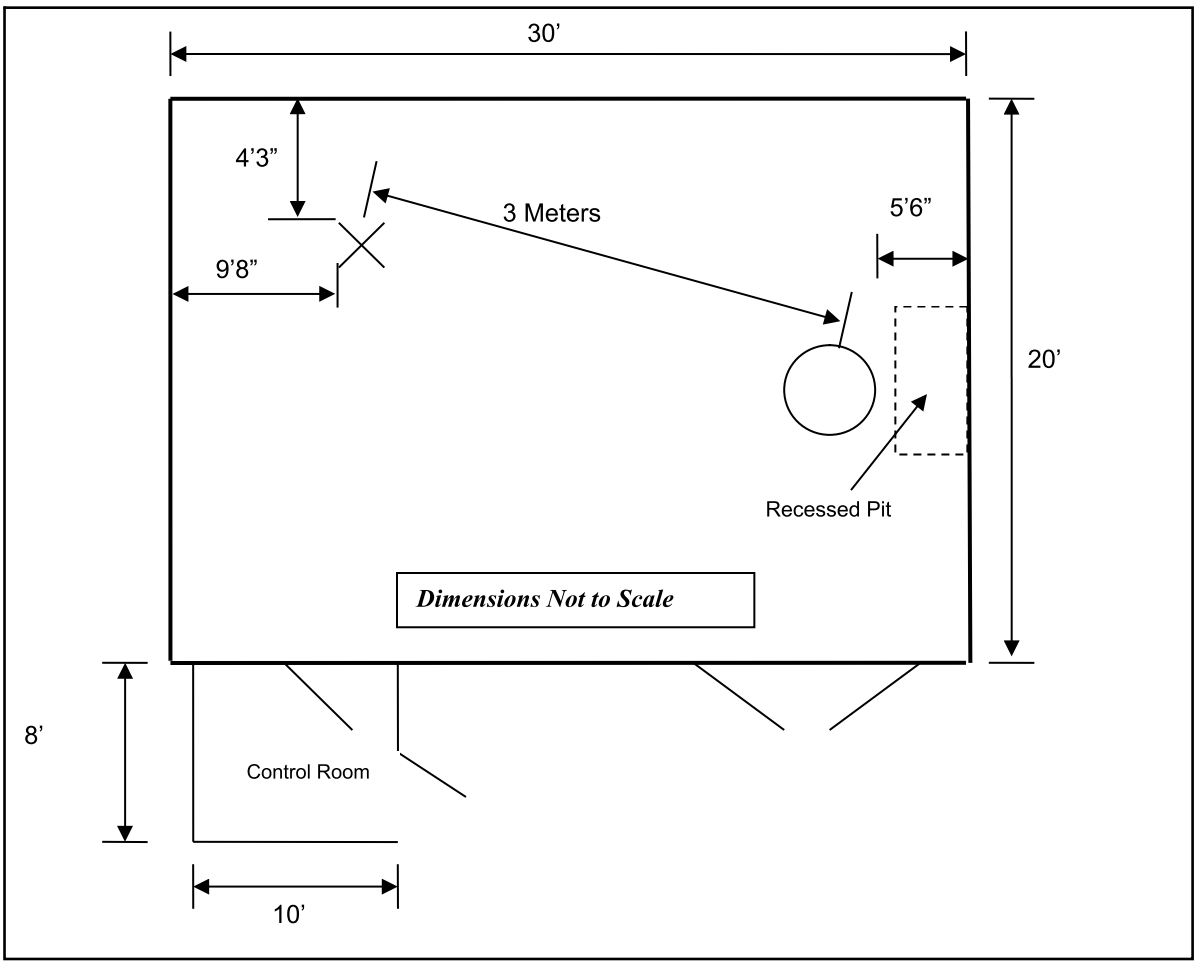


Figure 4.1.1.2-1: Semi-Anechoic Chamber Test Site

4.1.1.3 Fully Anechoic Chamber

The 3m fully anechoic chamber is used for pre-screening the EUT for emissions only. Final screening is performed on the OATS or in case of Class B EUT's, in the 3m semi-anechoic chamber. The Fully Anechoic Chamber has been characterized for field uniformity in accordance with IEC 61000-4-3 and can be used for final radiated fields immunity testing.

The Fully-Anechoic Chamber Test Site consists of a 24'L x 16'W x 12'H shielded enclosure. The chamber is fully lined with RF absorbing foam. The foam ranges in type from 8-24" conventional pyramidal cones, 8-12" conventional wedges and 6" and 16" Hybrid Foam over ferrite tile. The Hybrid material is placed in the 6 specular regions of the chamber for better low-frequency performance. The specular regions are 1) directly behind the receiving antenna, 2) on the floor between the receiving antenna and the EUT table, 3) the wall directly behind the EUT, 4&5) the side walls between the receiving antenna and the EUT table and 6) the ceiling between the receiving antenna and the EUT. The specular regions are 6' x 4' in size.

The chamber is grounded via 1 - 8' copper ground rod, installed at the center of the back wall, it is bound to the shield using 3/4" stainless steel braided cable.

The turntable is a remotely controlled EMCO Model 1060 and is 150cm in diameter and is located 1m from the absorber on the back wall of the chamber.

A diagram of the Fully Anechoic Chamber Test Site is shown in Figure 4.1.1.3-1 below:

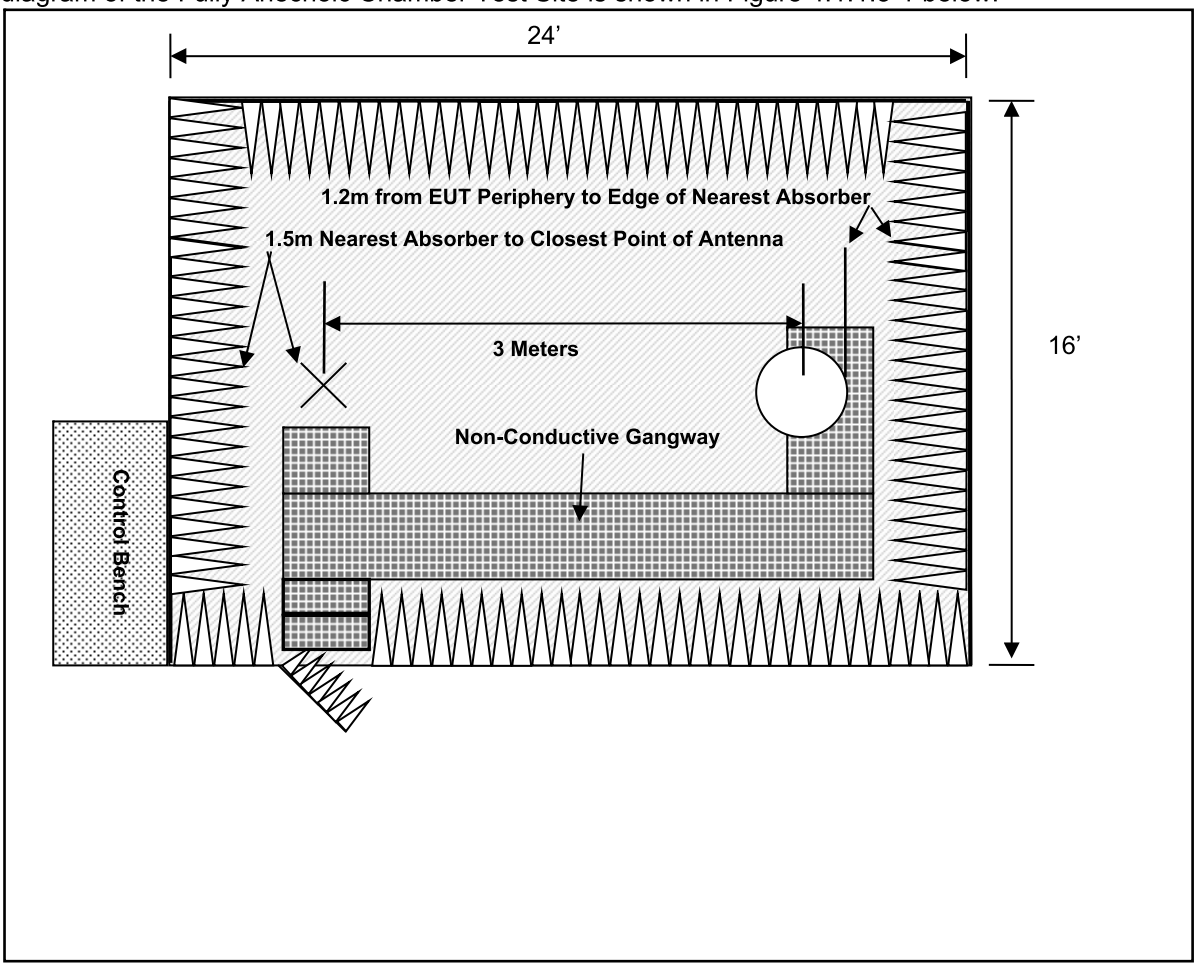


Figure 4.1.1.3-1: Fully Anechoic Chamber Test Site

4.1.2 Test Equipment

Table 4.1.2-1 identifies all equipment used for radiated emissions respectively.

Table 4.1.2-1 Test Equipment – Radiated Emissions

AssetID	Manufacturer	Model #	Equipment Type	Serial #	Last Calibration Date	Calibration Due Date
1	Rohde & Schwarz	ESMI - Display	Spectrum Analyzers	833771/007	7/11/2014	7/11/2015
2	Rohde & Schwarz	ESMI-Receiver	Spectrum Analyzers	839587/003	7/11/2014	7/11/2015
73	Agilent	8447D	Amplifiers	2727A05624	7/15/2014	7/15/2015
338	Fluke	8010A	Meters	3385330	NCR	NCR
204	ACS	204	Cables	204	NCR	NCR
167	ACS	Chamber EMI Cable Set	Cable Set	167	10/28/2014	10/28/2015
628	EMCO	6502	Antennas	9407-2877	2/7/2014	2/7/2016
40	EMCO	3104	Antennas	3211	2/14/2013	2/14/2015
412	Electro Metrics	LPA-25	Antennas	1241	7/24/2014	7/24/2016

NCR = No Calibration Required

4.1.3 Test Methodology

4.1.3.1 Pre-Scans

Radiated pre-scans are performed on all EUT's in either the 3m Semi-Anechoic or the 3m Fully-Anechoic Chamber. Final emission testing for Class A equipment is performed on the 3/10m Open Area Test Site (OATS) as described in section 4.1.1. Final emission testing on Class B equipment can be performed either in the 3m Semi-Anechoic chamber described in section 4.1.2 or on the OATS.

Pre-scans are a method by which the 10 highest emissions can be identified for final evaluation. This is achieved by taking automated emission snapshots of the EUT at various azimuths and antenna heights. The software is programmed to perform a peak sweep of the band using the maxhold function. This sweep is performed every 90º in both horizontal and vertical polarities and at antenna heights of 100cm and 300cm. Although not a fully maximized scan, the pre-scan gives a good indication of pass or fail.

4.1.3.2 Final Scans

Radiated emissions measurements were made over the frequency range of 150kHz – 1GHz. Quasi-Peak measurements are taken with the Spectrum Analyzer's resolution bandwidth was set to 120KHz and video bandwidth set to 300 kHz for measurements below 1000MHz. Average measurements above 1000MHz are taken using measurement instruments average detector. The calculation for the radiated emissions field strength is as follows:

Corrected Reading = Analyzer Reading + Cable Loss + Antenna Factor
Margin(dB) = Applicable Limit - Corrected Reading

4.1.3.3 Test Criteria

The EUT must meet the Class B Limits as given in section 1.4.1.

4.1.3.4 Test Justification

☒ **No justification - The EUT was tested per the appropriate test methods and test plan.**
☐ **The test method, standard, and/or test plan was deviated from for the following reason:**

4.1.4 Test Setup Photographs

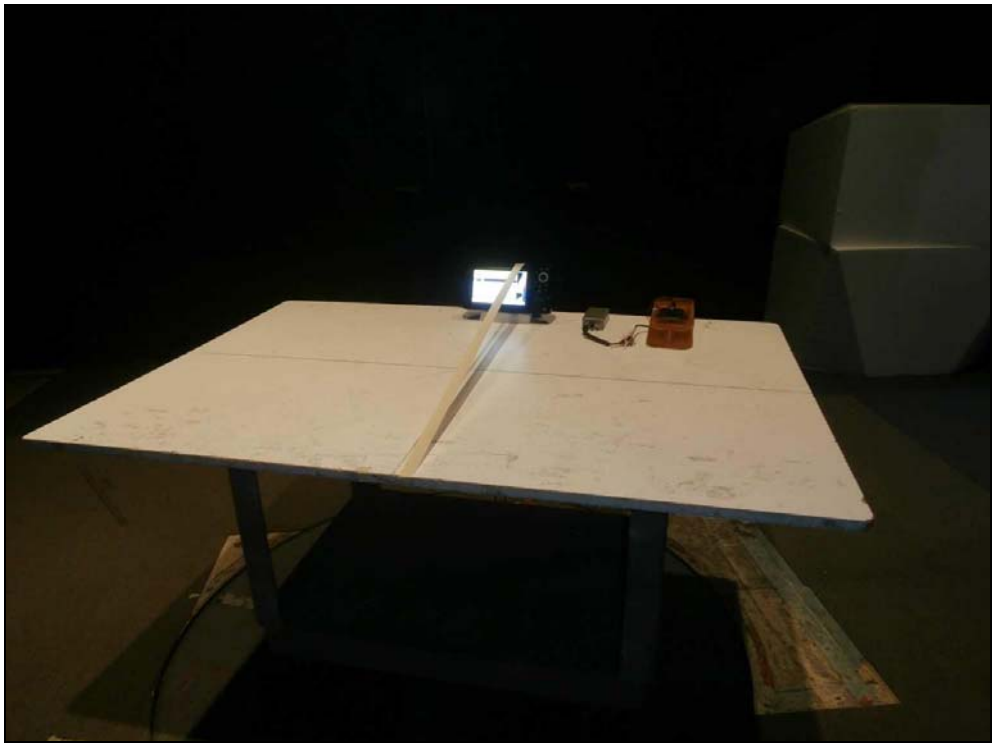


Figure 4.1.4-1: Radiated Emissions - Front View

Figure 4.1.4-2: Radiated Emissions - Rear View

4.1.5 Test Data

Final tabulated radiated emissions data are reported in the Test Data Table below:

Test Parameters:

Test Date:	**January 5, 2015**	**Temperature (ºC)**	**22**
Technician:	**Art Sumner**	**Humidity (%)**	**35**
Equipment Class:	**Class B**	**Barometric Pressure (mBar)**	**1031**
Tested Modes:	**Powered on; monitoring depth and speed**		
AC Input Power:	**N/A**		
DC Input Power:	**12Vdc**		

Test Data Table:

Measurement Distance:

☐ 1 Meter ☒ 3 Meter ☐ 10 Meter

Frequency (MHz)	Measured Level (dBuV)		Antenna Polarity (H/V)	Antenna Height (cm)	Turntable Position (o)	Correction Factors (dB)	Corrected Level (dBuV/m)		Limit (dBuV/m)		Margin (dB)	
	Pk	Qpk/Av					Pk	Qpk/Av	Pk	Qpk/Av	Pk	Qpk/Av
30.1	36.75	32.15	v	100	0	-13.22	---------	18.93	---------	54.0	---------	35.1
40.38	51.28	30.73	v	100	0	-14.69	---------	16.04	---------	54.0	---------	38.0
40.76	44.43	29.41	v	100	0	-14.68	---------	14.73	---------	54.0	---------	39.3
42.08	34.27	32.25	v	100	0	-14.66	---------	17.59	---------	54.0	---------	36.4
59.46	41.86	23.95	v	100	0	-14.03	---------	9.92	---------	54.0	---------	44.1
70.42	33.94	30.45	v	100	0	-17.03	---------	13.42	---------	54.0	---------	40.6
240	35.05	30.78	v	100	0	-13.50	---------	17.28	---------	54.0	---------	36.7
472.88	31.60	23.49	v	100	0	-6.08	---------	17.41	---------	54.0	---------	36.6
157.31	32.92	27.27	v	100	0	-10.68	---------	16.59	---------	24.0	---------	7.4

Qpk = Quasi-Peak Measurement or Limit (< 1GHz)
AV = Average Measurement or Limit (>1GHz)

Notes: No emissions of concern above 1GHz

4.2 Conducted Emissions

4.2.1 Conducted Emissions Test Site

The AC mains conducted EMI site is located in the main EMC lab. It consists of an 8' x 8' solid aluminum horizontal ground reference plane (GRP) bonded every 3" to an 8' X 8' vertical ground plane.

A diagram of the room is shown below in figure 4.2.1-1:

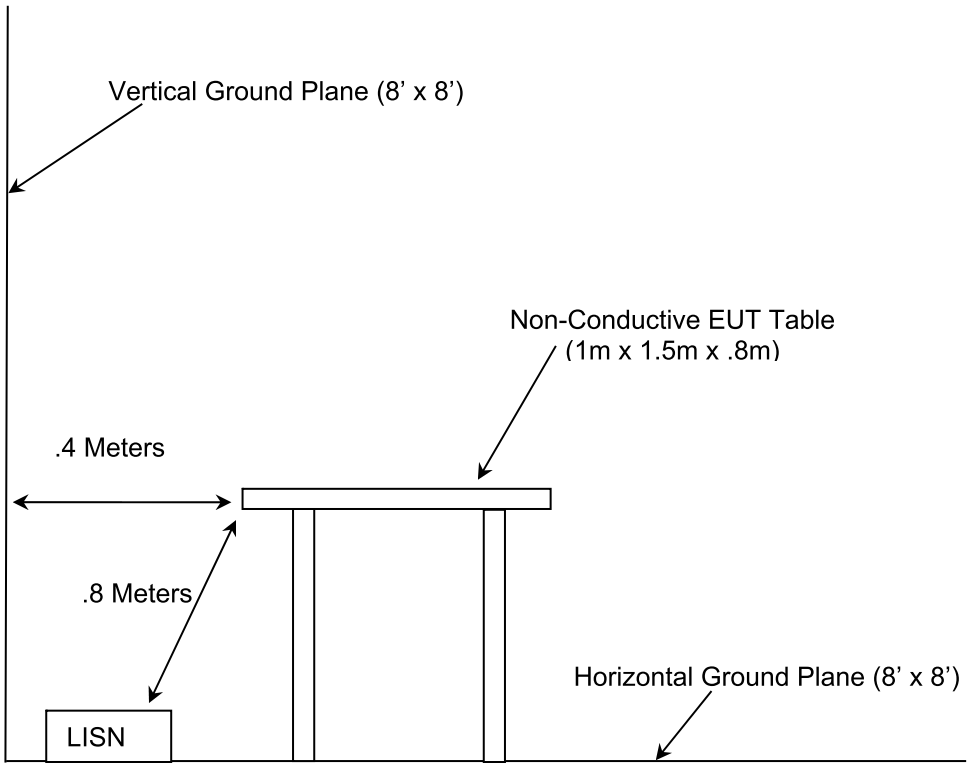


Figure 4.2.1-1: AC Mains Conducted EMI Site

4.2.2 Test Equipment

Table 4.2.2-1 Test Equipment – Conducted Emissions

AssetID	Manufacturer	Model #	Equipment Type	Serial #	Last Calibration Date	Calibration Due Date
168	Hewlett Packard	11947A	Attenuators	44829	1/19/2015	1/19/2016
324	ACS	Belden	Cables	8214	6/4/2014	6/4/2015
316	Rohde Schwarz	ESH3-Z5	LISN	861189-010	10/30/2014	10/30/2015
RE361	Agilent	AT/E7405A	Analyzers	MY42000089	5/30/2014	5/30/2015
321	Hewlett Packard	HPC 8447D	Amplifiers	1937A02809	7/14/2014	7/14/2015

NCR=No Calibration Required

4.2.3 Test Methodology

Conducted emissions were performed from 150kHz to 30MHz with the spectrum analyzer's resolution bandwidth set to 9kHz and the video bandwidth set to 30kHz. The calculation for the conducted emissions is as follows:

Corrected Reading = Analyzer Reading + LISN Loss + Cable Loss
Margin = Applicable Limit - Corrected Reading

4.2.3.1 Test Criteria

The EUT must meet the Class B Limits as given in section 1.4.1.

4.2.3.2 Test Justification

☒ **No justification - The EUT was tested per the appropriate test methods and test plan.**
☐ **The test method, standard, and/or test plan was deviated from for the following reason:**

4.2.4 Test Setup Photographs

Figure 4.2.4-1: Conducted Emissions Test Setup – Front View

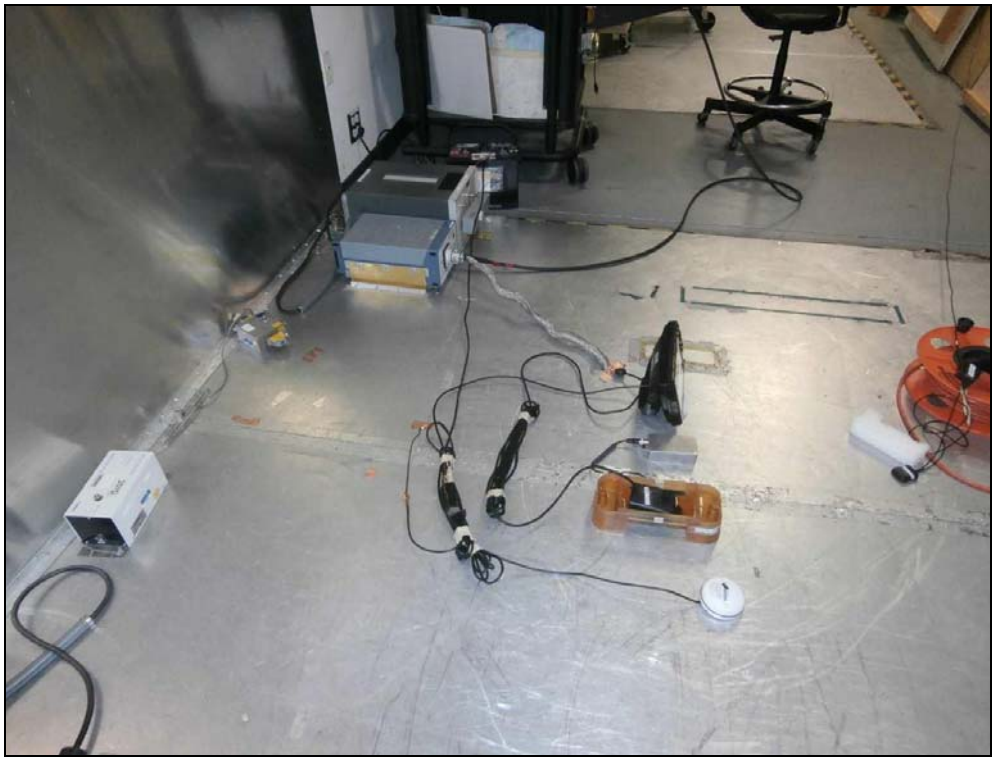


Figure 4.2.4-2: Conducted Emissions Test Setup – Side View

4.2.5 Test Data

Tabulated data is given in the Test Data Tables below.

Test Parameters:

Test Date:	**January 15, 2015**	**Temperature (ºC)**	**26**
Technician:	**Art Sumner**	**Humidity (%)**	**34**
Equipment Class:	**Class B**	**Barometric Pressure (mBar)**	**1016**
Tested Modes:	**Powered on; Monitoring depth, speed, GPS connection**		
AC Input Power:	**N/A**		
DC Input Power:	**12Vdc Battery**		

Tested Leads:

☐ **AC Mains – Number of Lines:**
☒ **DC Mains – Number of Lines: 2**
☐ **Telecom Port – Quantity:**

Test Data Tables:

Check All That Apply to This Data
☒ **Line 1** ☐ **Line 2**
☐ **Line 3** ☐ **Line 4**
☐ **To Ground** ☒ **Floating**
☐ **Telecom Port _____**
☒ **dBµV** ☐ **dBµA**

Power Supply Description: 12Vdc

Frequency (MHz)	Uncorrected Reading		Total Correction Factor (dB)	Corrected Level		Limit		Margin (dB)	
	Quasi-Peak	Average		Quasi-Peak	Average	Quasi-Peak	Average	Quasi-Peak	Average
0.011	9.92	6.83	15.16	25.08	21.99	94.3811321	66.00	69.3	
0.0368	24.89	23.67	11.19	36.08	34.86	73.8696918	66.00	37.8	
0.073	20.23	17.26	10.49	30.72	27.75	62.2354429	66.00	31.5	
0.0802	18.17	10.74	10.45	28.62	21.19	60.6377405	66.00	32.0	
0.096	16.06	8.45	10.42	26.48	18.87	57.5833721	66.00	31.1	
0.15	13.28	5.51	10.37	23.65	15.88	50.0030709	66.00	26.4	
1.25	24.63	23.42	10.19	34.82	33.61	50	60.00	15.2	

Notes:

Check All That Apply to This Data
☐ Line 1 ☒ Line 2
☐ Line 3 ☐ Line 4
☐ To Ground ☒ Floating
☐ Telecom Port _____
☒ dBµV ☐ dBµA

Power Supply Description: 12Vdc

Frequency (MHz)	Uncorrected Reading		Total Correction Factor (dB)	Corrected Level		Limit		Margin (dB)	
	Quasi-Peak	Average		Quasi-Peak	Average	Quasi-Peak	Average	Quasi-Peak	Average
0.011	11.66	7.41	15.16	26.82	22.57	94.3811321	66.00	67.6	
0.0368	17.04	14.53	11.19	28.23	25.72	73.8696918	66.00	45.6	
0.076	13.08	4.78	10.49	23.57	15.27	61.5513804	66.00	38.0	
0.081	13.06	4.79	10.45	23.51	15.24	60.4691509	66.00	37.0	
0.093	12.12	4.05	10.42	22.54	14.47	58.1226319	66.00	35.6	
1.252	27.17	25.92	10.19	37.36	36.11	50	60.00	12.6	

Notes:

5.0 Harmonic Current Emissions

5.1 Test Justification

☐ No justification - The EUT was tested per the appropriate test methods and test plan.
☒ The test method, standard, and/or test plan was deviated from for the following reason:

This test is not applicable, because the EUT is not powered through an AC Mains power supply.

6.0 Voltage Fluctuations & Flicker

6.1 Test Justification

☐ No justification - The EUT was tested per the appropriate test methods and test plan.
☒ The test method, standard, and/or test plan was deviated from for the following reason:

This test is not applicable, because the EUT is not powered through an AC Mains power supply.

SECTION C: IMMUNITY – TEST INFORMATION AND RESULTS

7.0 Electrostatic Discharge Immunity

7.1 Test Site Description

The EUT was configured and connected to satisfy its functional requirements.

For a table top configuration, the EUT was placed on an insulating support of 0.5mm in the center of the Horizontal Coupling Plane (HCP). The HCP laid flat on a non-conductive table measuring 1.6 meters x 0.8 meters x 0.8 meters. The non-conductive table was placed on a 16 feet x 8 feet Ground Reference Plane (GRP). The Vertical Coupling Plane was placed 10cm from the EUT and insulated from the HCP.

For a floor standing configuration the EUT was placed on a 10cm insulated support. The non-conductive spacer was placed on a 16 feet x 8 feet Ground Reference Plane (GRP). The Vertical Coupling Plane was placed 10cm from the EUT.

Both the HCP and the VCP were connected to the GRP via cables with 470kΩ resistors located at each end. The ground lead of the ESD generator was also connected to the GRP.

7.2 Test Equipment

Table 7.2-1: Test Equipment List

AssetID	Manufacturer	Model #	Equipment Type	Serial #	Last Calibration Date	Calibration Due Date
582	Kikusui	KES4021A	ESD Gun	SA003046	2/20/2014	2/20/2015
144	Omega	RH411	Climate Monitoring Equipment	H0103373	7/24/2014	7/24/2016
RE80	Tektronix	TDS 784C	Oscilloscope	7846	7/30/2013	7/30/2015
371	Fluke	Fluke 115	Meters	93872717	7/10/2014	7/10/2016

NCR = No Calibration Required

7.3 Test Methodology

IEC 61000-4-2 - Electromagnetic compatibility (EMC) - Part 4. Testing and measurement techniques - Section 4.2 Electrostatic discharge immunity test - Basic EMC Publication, was the guiding document for this test. The purpose of this test is to verify the immunity of single devices or systems against electrostatic discharges (ESD) generated by an operator or object touching the equipment, or by objects or persons coming into contact in the vicinity of the equipment.

Only areas of the EUT that are accessible to the user are considered for the evaluation.

Direct Contact Discharge

Devices with accessible conductive surfaces are subject to direct contact discharges. Each test point identified was subjected to 10 discharges of both positive and negatives impulses.

Indirect Contact Discharge

The EUT was subjected to indirect contact discharges to a horizontal coupling plane (HCP). At least 10 single discharges in both polarities were applied to the EUT via the HCP on all sides and at a separation distance of 10cm. In addition the EUT was subjected indirect discharges to a vertical coupling plane (VCP). At least 10 single discharges in both polarities were applied to the EUT via the VCP on all sides and at a separation distance of 10cm.

Air Discharge

Insulated surfaces of the EUT that are accessible were subjected to air discharges. Each test point is subjected to 10 discharges of each polarity.

7.3.1 Test Criteria

EN 60945:2002 requires performance criterion B to be met as described in section 1.4.2.

7.3.2 Test Justification

☒ No justification - The EUT was tested per the appropriate test methods and test plan.
☐ The test method, standard, and/or test plan was deviated from for the following reason:

7.4 Test Setup Photograph

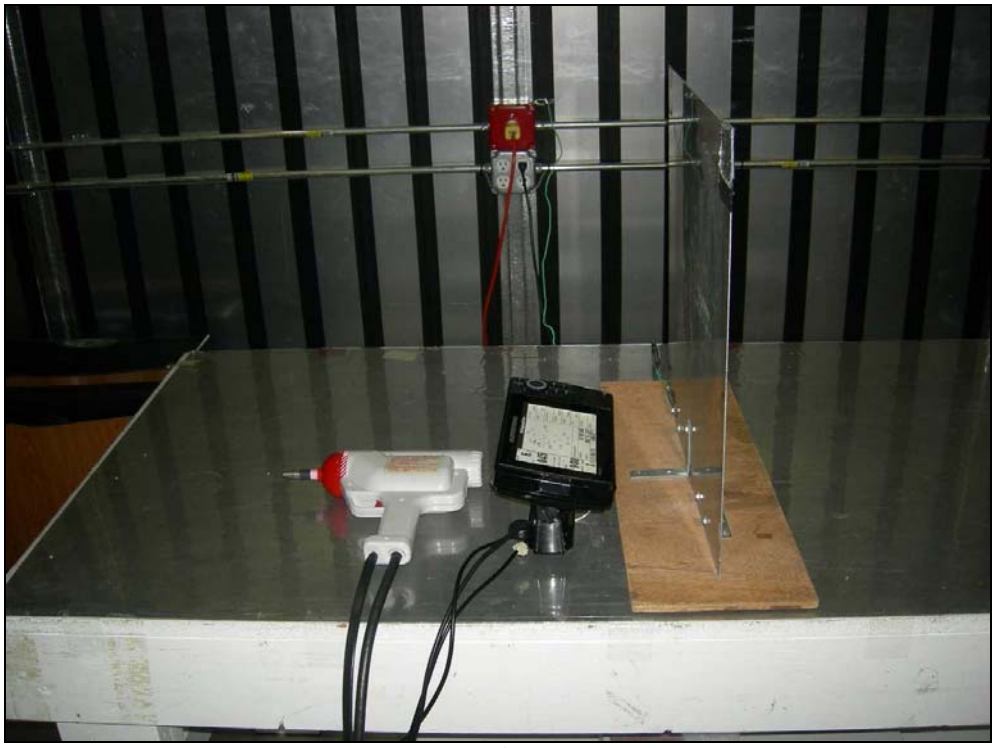
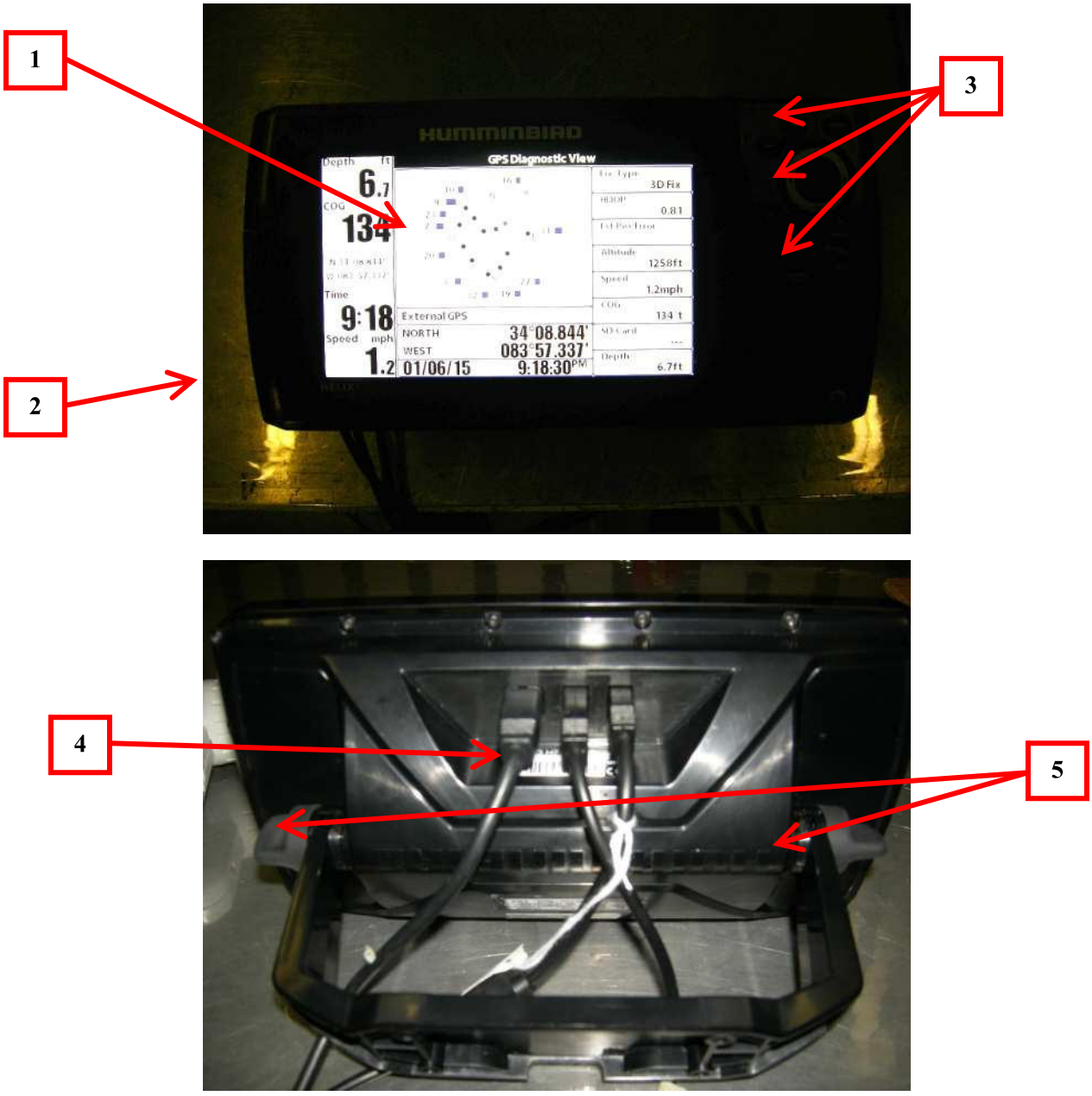


Figure 7.4-1: Test Setup Photograph

7.5 ESD Data Sheet

Test Point Photograph:



Test Point Selection:

TEST POINT#	DESCRIPTION	TYPE (C/A)	TEST POINT#	DESCRIPTION	TYPE (C/A)
1	Display screen center and edges	**Air**	4	Molded connectors and cables	**Air**
2	Cabinet edges and seem	**Air**	5	Mounting knob	**Air**
3	Buttons	**Air**			

7.6 Test Data

Test Parameters:

Test Date:	January 6, 2015	Temperature (ºC)	21
Technician:	Wayne Orwig	Humidity (%)	34
Equipment Class:	N/A	Barometric Pressure (mBar)	1022
Tested Modes:	GPS and transducer active		
AC Input Power:	N/A	VCP Resistor Value Check:	949k ohms
DC Input Power:	12Vdc Battery	HCP Resistor Value Check:	936k ohms

Indirect Contact Discharge:

Check All That Apply to This Data

Plane:	Polarity:	Tested Levels:	
☐ Vertical Coupling Plane	☐ Positive	☒ 2kV	☐ 8kV
☐ Horizontal Coupling Plane	☐ Negative	☒ 4kV	☐ 15kV
☒ Both	☒ Both	☒ 6kV	☐ Enter Other Level Here

Side	Result	Observation (Describe any detectable event)
Front	Pass	
Rear	Pass	
Left	Pass	
Right	Pass	
Bottom	Pass	

Notes:

Air and Direct Contact Discharge:

Check All That Apply to This Data

Polarity:	Tested Levels:	
☐ Positive	☒ 2kV	☒ 8kV
☐ Negative	☒ 4kV	☐ 15kV
☒ Both	☐ 6kV	☐ Enter Other Level Here

Test Point	Discharge Type	Result	Observation (Describe any detectable event)
1	Air	Pass	
2	Air	Pass	
3	Air	Pass	
4	Air	Pass	
5	Air	Pass	

Notes:

8.0 Radio-Frequency Electromagnetic Fields

8.1 Test Site Description

The radiated fields test was performed in the semi or fully-anechoic chamber described in section 4.1.1.2 or 4.1.1.3 respectively.

8.2 Test Equipment

Table 8.2-1: Test Equipment List

AssetID	Manufacturer	Model #	Equipment Type	Serial #	Last Calibration Date	Calibration Due Date
251	Rohde & Schwarz	SML03	Signal Generators	102116	10/30/2014	10/30/2015
329	A.H.Systems	SAS-571	Antennas	721	7/15/2013	7/15/2015
370	IFI	CMX5002	Amplifier	L364-0407	NCR	NCR
642	Fairview Microwave	FMC0101951-200CM	Cables	N/A	NCR	NCR
326	ACS	EMI Cable Set-FAC	Cables	326	7/18/2014	7/18/2015
354	ETS Lindgren	3142C	Antennas	78838	NCR	NCR
1112	Wandel & Goltermann	BN2244/21	Probes	H0006	11/11/2014	11/11/2015
1201	Wandel & Goltermann	2244/99.22	Probes	W-0004	11/11/2014	11/11/2015
494	Omega	iBTHX-W	Climate Monitoring Equipment	9460211	8/12/2014	8/12/2016
RE89	Amplifier Research	25S1G4A	Amplifiers	324609	NCR	NCR
564	United Microwave Products, Inc.	AO-190-00.36.0	Cables	564	7/18/2014	7/18/2015

NCR = No Calibration Required

8.3 Test Methodology

IEC 61000-4-3 Ed. 3.- Electromagnetic compatibility (EMC) - Part 4. Testing and measurement techniques - Section 3: Radiated, radio-frequency, electromagnetic field immunity test, was the guiding document for this test. The purpose of this test is to verify the immunity of single devices or systems when subjected to radio-frequency electromagnetic field.

The EUT was configured and connected to satisfy its functional requirements. One representative sample was placed on the table and rotated 90° to expose all side of the EUT to the radiofrequency electromagnetic field. The table is non-conductive measuring 1.5 meters x 1.0 meters x 0.8 meters. The non-conductive table was placed 3 meters from the radiating antenna.

The frequency ranges to be considered are swept with the signal 80% amplitude modulated with a 1kHz AM sine wave, pausing to adjust the RF signal level or to switch oscillators and antennas as necessary. Where the frequency range is swept incrementally, the step size shall not exceed 1% of fundamental with linear interpolation between calibrated points.

The test shall normally be performed with the generating antenna facing each of the four sides of the EUT, however if the equipment can be used in different orientations, the test shall be performed on all sides, 6 total.

The polarization of the field generated by each antenna necessitates testing each side twice, once with the antenna positioned vertically and again with the antenna positioned horizontally.

8.3.1 Test Criteria

EN 60945:2002 requires criterion A to be met as described in section 1.4.2.

8.3.2 Test Justification

☒ **No justification - The EUT was tested per the appropriate test methods and test plan.**
☐ **The test method, standard, and/or test plan was deviated from for the following reason:**

8.4 Test Setup Photographs

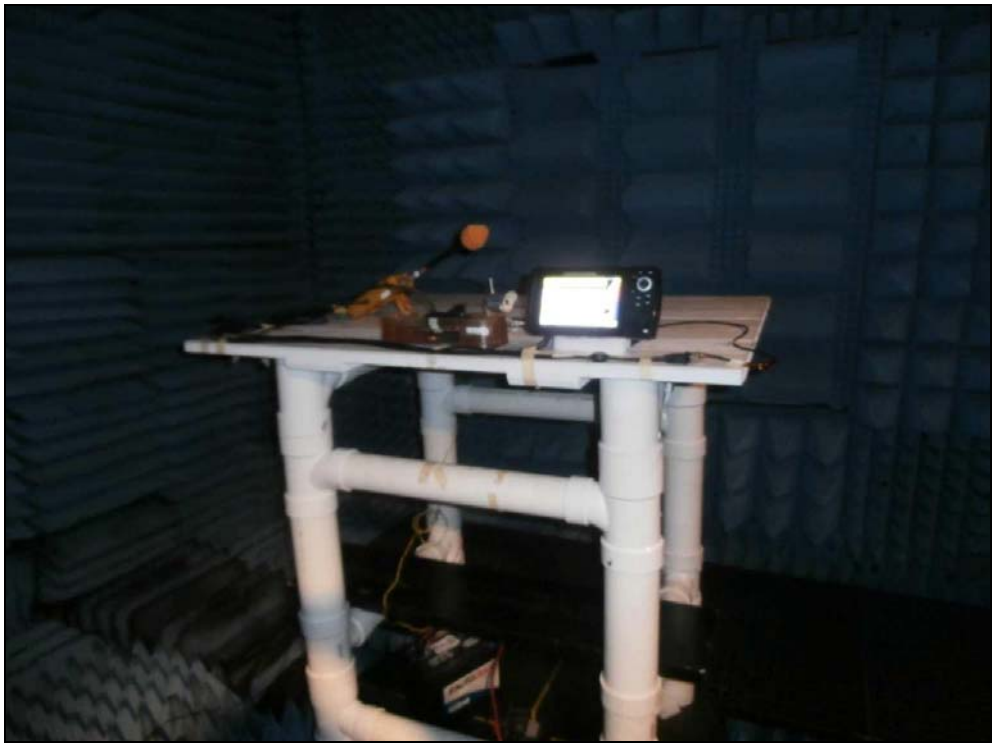


Figure 8.4-1: Test Setup Photograph

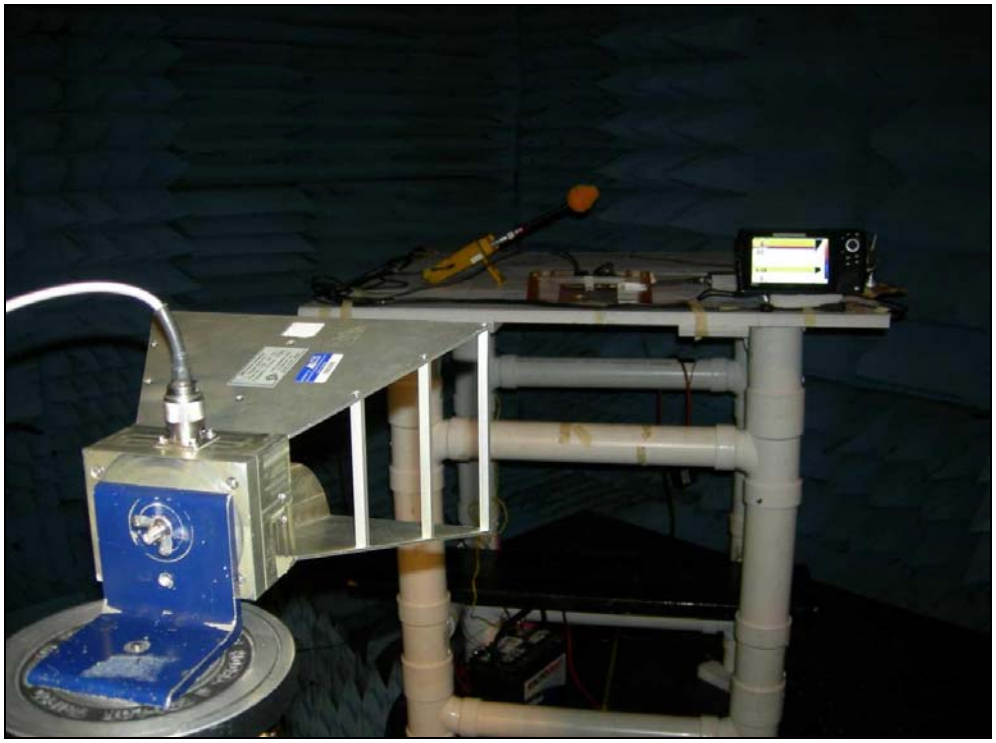


Figure 8.4-2: Test Setup Photograph

8.5 Test Results

Test Parameters:

Test Date:	**January 5, 2015**	**Temperature (ºC)**	**23**
Technician:	**Art Sumner / Sean Vick**	**Humidity (%)**	**34**
Equipment Class:	**N/A**	**Barometric Pressure (mBar)**	**1029**
Tested Modes:	**Monitoring depth, speed, temperature, and GPS coordinates**		
AC Input Power:	**N/A**		
DC Input Power:	**12Vdc Battery**		

Test Data:

Check All That Apply to This Data

Polarity	Field Strength:	Freq. Band:	Dwell Time
☐ Horizontal	☐ 3V/m	☒ 80-1000MHz	☐ 1 Second
☐ Vertical	☒ 10V/m	☐ 80-2700MHz	☒ 3 Seconds
☒ Both	☐ 8V/m	☐ Enter Other Band Here	☐ Enter Other
	☐ Enter Other Level Here		

Azimuth	Result	Observation (Describe any detectable event)
0	Pass	
90	Pass	
180	Pass	
270	Pass	

Notes:
400Hz modulation to a deth of 80%

Test Data:

Check All That Apply to This Data

Polarity	Field Strength:	Freq. Band:	Dwell Time
☐ Horizontal	☐ 3V/m	☐ 80-1000MHz	☐ 1 Second
☐ Vertical	☒ 10V/m	☐ 80-2700MHz	☐ 3 Seconds
☒ Both	☐ 8V/m	☒ 1.0-2.0GHz	☒ 8.6 Seconds
	☐ Enter Other Level Here		

Azimuth	Result	Observation (Describe any detectable event)
0	Pass	
90	Pass	
180	Pass	
270	Pass	

Notes:
400Hz modulation to a depth of 80%

9.0 Electrical Fast Transient/Bursts

9.1 Test Site Description

The EUT was configured and connected to satisfy its functional requirements. The EUT was placed in the center of a non-conductive support measuring 125cm x 96cm x 10 cm. The non-conductive support is placed on a 8 feet x 8 feet Ground Reference Plane (GRP). A minimum distance of 50 cm between the EUT and all other conductive structures was maintained. A minimum distance of 50 cm between the coupling clamp and all other conductive structures, except the GRP, was maintained. A 10 cm insulated support was placed between the capacitive coupling clamp and the GRP. The GRP was bonded to the EFT/B generator.

The input power port of the EUT was tested using the coupling/decoupling network. The +/-1kV bursts were applied to all lines individually as well as simultaneously.

The bursts were applied to the signal/control line ports, if present, using the capacitive coupling clamp.

9.2 Test Equipment

Table 9.2-1: Test Equipment List

AssetID	Manufacturer	Model #	Equipment Type	Serial #	Last Calibration Date	Calibration Due Date
62	Haefely Trench	EFT Clamp	Immunity Equipment	None	10/2/2014	10/2/2015
474	Keytek	EMC PRO	General Lab Equipment	9808246	10/2/2014	10/2/2015
494	Omega	iBTHX-W	Climate Monitoring Equipment	9460211	8/12/2014	8/12/2016
336	Tektronix	TDS 1012B	Scopes	C010189	7/12/2014	7/12/2015
611	Teseq	INA 265B	Attenuators	73054	9/12/2013	9/12/2015
503	Key Tek	TC-50	Cables	n/a	12/30/2014	12/30/2015

NCR = No Calibration Required

9.3 Test Methodology

IEC 61000-4-4 - Electromagnetic compatibility (EMC) - Part 4. Testing and measurement techniques - Section 4: Electrical fast transient/burst immunity test - Basic EMC Publication., was the guiding document for this test. The purpose of this test is to verify the immunity of single devices or systems when subjected to types of transient disturbances such as those originating from switching transients such as interruption of inductive loads or relay contact bounce.

9.3.1 Test Criteria

EN 60945:2002 requires criterion B to be met as described in section 1.4.2.

9.3.2 Test Justification

☒ **No justification - The EUT was tested per the appropriate test methods and test plan.**
☐ **The test method, standard, and/or test plan was deviated from for the following reason:**

9.4 Test Setup Photographs

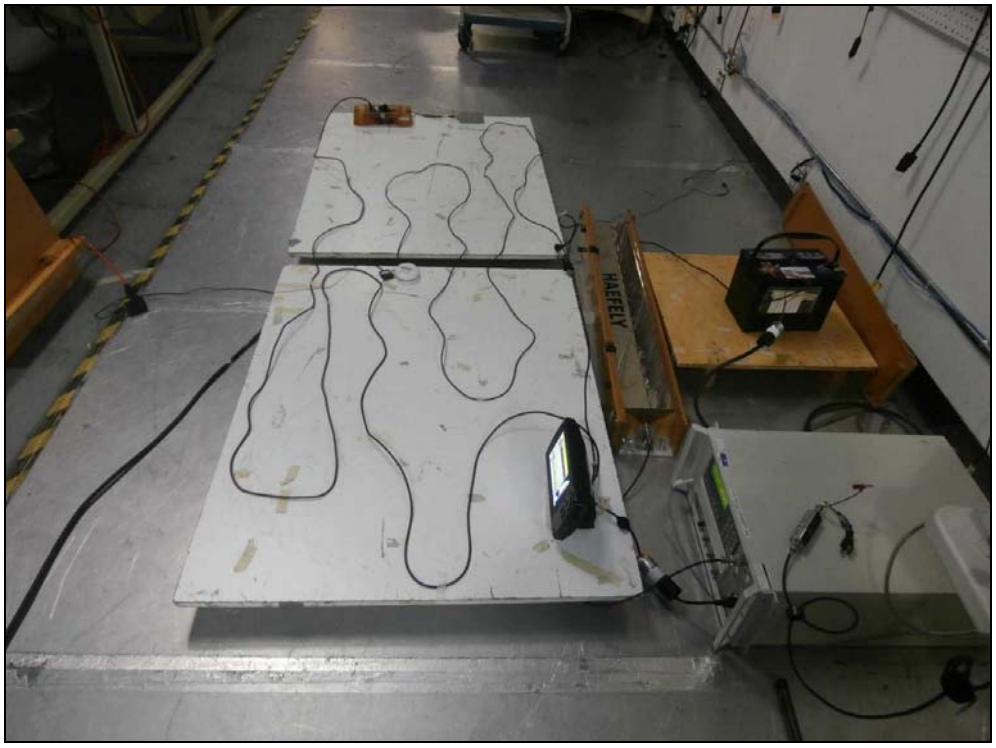


Figure 9.4-1: Test Setup Photograph

Figure 9.4-2: Test Setup Photograph

9.5 Test Results

Test Parameters:

Test Date:	**January 6, 2015**	**Temperature (ºC)**	**22**
Technician:	**Wayne Orwig**	**Humidity (%)**	**30**
Equipment Class:	**N/A**	**Barometric Pressure (mBar)**	**1022**
Tested Modes:	**GPS and transducer operating**		
AC Input Power:	**N/A**		
DC Input Power:	**12Vdc**		

Mains Test Data:

Check All That Apply to This Data

Polarity:	Tested Levels:	Interface Type:
☐ Positive	☒ .5kV	☒ Input
☐ Negative	☐ 1kV	☐ Output
☒ Both	☐ 2kV	☐ Both
	☐	

Coupling Mode	Result	Observation (Describe any detectable event)
L1	Pass	
L2	Pass	
L1-L2	Pass	

Notes:

Signal Line Test Data:

Check All That Apply to This Data

Polarity:	Tested Levels:
☐ Positive	☒ .25kV
☐ Negative	☒ .5kV
☒ Both	☐ 1kV
	☐ 2kV
	☐ Enter Other Level Here

Signal Line	Result	Observation (Describe any detectable event)
GPS cable	Pass	
Transducer cable	Pass	

Notes:

10.0 Surge Immunity

10.1 Test Justification

☐ No justification - The EUT was tested per the appropriate test methods and test plan.
☒ The test method, standard, and/or test plan was deviated from for the following reason:

This test is not applicable, because the EUT is not powered through an AC Mains power supply.

11.0 Radio-Frequency Common-Mode Immunity

11.1 Test Site Description

The EUT was configured and connected to satisfy its functional requirements. The EUT was placed on an insulating support of 0.1m height above a ground reference plane. All relevant cables were provided with the appropriate coupling and decoupling devices at a distance between 0.1m and 0.3m from the projected geometry of the EUT on the Ground Reference Plane (GRP).

11.2 Test Equipment

Table 11.2-1: Test Equipment List

AssetID	Manufacturer	Model #	Equipment Type	Serial #	Last Calibration Date	Calibration Due Date
370	IFI	CMX5002	Amplifier	L364-0407	NCR	NCR
251	Rohde & Schwarz	SML03	Signal Generators	102116	10/30/2014	10/30/2015
425	ACS	EMC Cable Set	Cable Set	425	NCR	NCR
642	Fairview Microwave	FMC0101951-200CM	Cables	N/A	NCR	NCR
624	Advantest	R3261C	Spectrum Analyzers	31720426	NCR	NCR
471	Bird Technologies Group	150-A-FFN-06	Attenuators	914	NCR	NCR
457	Com Power	CDN-M2-25	Coupler	511023	10/29/2014	10/29/2015
364	Amplfier Research	DC2600A	Coupler	322466	NCR	NCR
181	COM-POWER	m1-25	CDN's	501001	NCR	NCR
93	Chase	8101	Clamp	65	5/7/2014	5/7/2015

NCR = No Calibration Required

11.3 Test Methodology

IEC 61000-4-6 3rd Ed. - Electromagnetic compatibility (EMC) - Part 4: Testing and measurement techniques - Section 6: Immunity to conducted disturbances, induced by radio- frequency fields, was the guiding document for this test. The purpose of this test is to verify the immunity of single devices or systems when subjected to radio-frequency electromagnetic field.

The EUT was caused to operate as intended and monitored for changes in performance. The frequency range is swept from 150 kHz to 80MHz, using the signal levels established during the setting process, and with the disturbance signal 80% amplitude modulated with a 1kHz AM sine wave, pausing to adjust the RF signal level or to switch coupling devices as necessary. The rate of sweep shall not exceed 1.5 x 10^{-3} decades. Where the frequency is swept incrementally, the step size shall not exceed 1% of the start and thereafter 1% of the preceding frequency value.

11.3.1 Test Criteria

EN 60945:2002 requires criterion A to be met as described in section 1.4.2.

11.3.2 Test Justification

☒ **No justification - The EUT was tested per the appropriate test methods and test plan.**
☐ **The test method, standard, and/or test plan was deviated from for the following reason:**

11.4 Test Setup Photographs

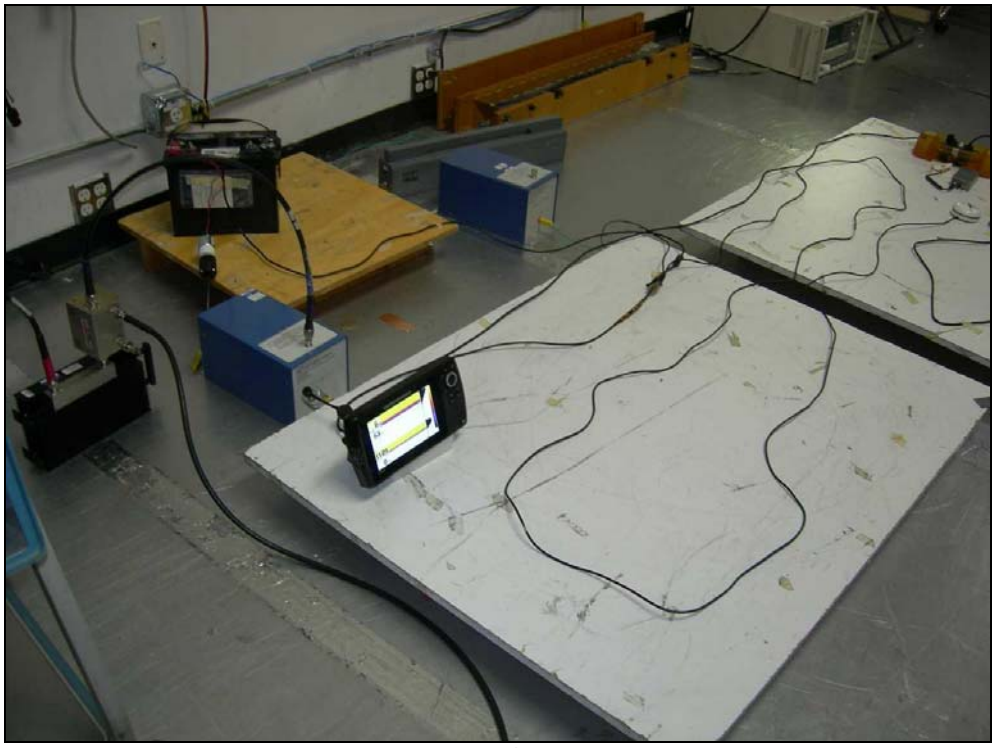


Figure 11.4-1: Test Setup Photograph

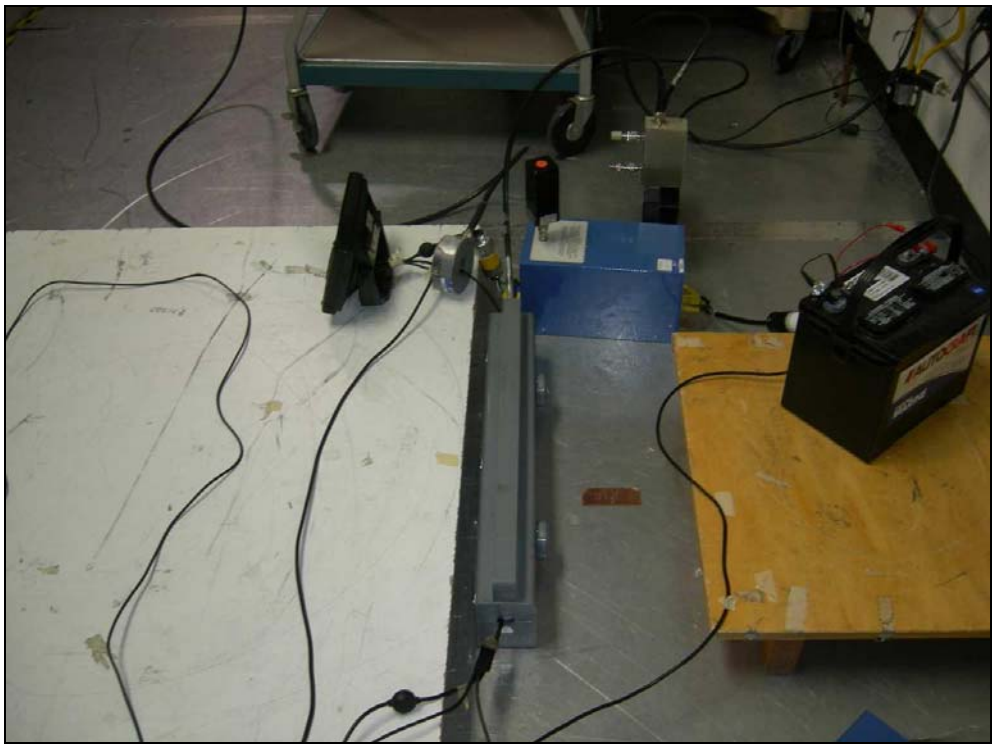


Figure 11.4-2: Test Setup Photograph

11.5 Test Results

Test Parameters:

Test Date:	**January 6, 2015**	**Temperature (ºC)**	**22**
Technician:	**Tommy Payton**	**Humidity (%)**	**30**
Equipment Class:	**N/A**	**Barometric Pressure (mBar)**	**1023**
Tested Modes:	**Monitoring Depth 6.7" & Graphics, Temperature, GPS, Time and Speed at 0mph.**		
AC Input Power:	**N/A**		
DC Input Power:	**12Vdc**		

Mains Test Data:

Check All That Apply to This Data

Test Level:
☒ 3Vrms
☐ 10Vrms
☐ 15Vrms
☐ Enter Other Level Here

Freq. Band:
☒ .150-80MHz
☐ Enter Other Band Here

Coupling Mode	Result	Observation (Describe any detectable event)
CDN	Pass	

Notes:
Spot frequency test at 10Vrms for 2.0, 3.0, 4.0, 6.2, 8.2, 12.6, 16.5, 18.8, 22 and 25 MHz. All at 400Hz AM@80%.

Signal Line Test Data:

Check All That Apply to This Data

Test Level:
☒ 3Vrms
☐ 10Vrms
☐ 15Vrms
☐ Enter Other Level Here

Freq. Band:
☒ .150-80MHz
☐ Enter Other Band Here

Signal Line	Result	Observation (Describe any detectable event)
GPS Cable	Pass	Graphics have noise from around 150k to 280kHz. Depth, Temperature, GPS, Time and Speed function properly.
Transducer Cable	Pass	Graphics have noise from around 150k to 630kHz. Depth, Temperature, GPS, Time and Speed function properly.

Notes:
Spot frequency test at 10Vrms for 2.0, 3.0, 4.0, 6.2, 8.2, 12.6, 16.5, 18.8, 22 and 25 MHz. All at 400Hz AM@80%.

12.0 Power Frequency Magnetic Fields Immunity

12.1 Test Justification

☐ No justification - The EUT was tested per the appropriate test methods and test plan.
☒ The test method, standard, and/or test plan was deviated from for the following reason:

This test is not applicable, because the EUT does not employ magnetically sensitive components.

13.0 Voltage Dips and Interruptions

13.1 Test Justification

☐ No justification - The EUT was tested per the appropriate test methods and test plan.
☒ The test method, standard, and/or test plan was deviated from for the following reason:

This test is not applicable, because the EUT is not powered through an AC Mains power supply.

SECTION D: MEASUREMENT UNCERTAINTY

General
Measurement Uncertainty is based on the following publications:

- CISPR 16-4-2: Uncertainties, statistics and limit modeling – Uncertainty in EMC measurements
- The Guide to the Expression of Uncertainty in Measurement(GUM): 1995
- ANSI / NCSL Z540.2-1997 (R2002) U.S. Guide to Expression of Uncertainty in Measurement

Calculations for measurement uncertainty are available upon request.

Emissions:

Test Method	U_{Lab}	U_{CISPR}	Uncertainty Units
Radiated Emissions 30MHz-1000MHz	3.68	5.2	dB
Radiated Emissions 30MHz to 200MHz	3.79	5.2	dB
Radiated Emissions 200 to 1000MHz	3.62	5.2	dB
Radiated Emissions 1-18GHz	3.65	---	dB
Conducted Emissions .150k-30MHz	1.52	3.6	dB
Radiated Disturbances 5MHz to 30MHz	2.81	4.5	dB
Radiated Disturbances 30MHz to 950MHz	2.21	4.5	dB
Harmonic Current Emissions	1.7	---	%
Voltage Fluctuations & Flicker	1.7	---	%
Insertion Loss/Internal Calibrations	.65	---	dB
Radiated Immunity 80-1000MHz	1.21	---	dB
Conducted Immunity .150-80MHz	1.64	---	dB
Frequency Interpolations	.81 (ave)	---	dB

NOTE U_{cispr} resembles a value of measurement uncertainty for a specific test, which was determined by considering uncertainties associated with the quantities listed in CISPR 16-4-2:2003 Section 4.2. Where no value is given for U_{cispr} the procedure below does not apply.

Compliance or non-compliance with a disturbance limit shall be determined in the following manner.

If U_{Lab} is less than or equal to U_{cispr} in Table 5.0-1, then:
- compliance is deemed to occur if no measured disturbance exceeds the disturbance limit;
- non-compliance is deemed to occur if any measured disturbance exceeds the disturbance limit.

If U_{Lab} is greater than U_{cispr}, then:
- compliance is deemed to occur if no measured disturbance, increased by ($U_{Lab} – U_{cispr}$), exceeds the disturbance limit;
- non-compliance is deemed to occur if any measured disturbance, increased by ($U_{Lab} – U_{cispr}$), exceeds the disturbance limit.

The ACS calculated MU is much less than the internationally accepted MU, therefore an adjustment to the measured result as mentioned above is not necessary.

Immunity
The EUT was subjected to the appropriate test levels required by the standard with a confidence level of 95%(k=2).

SECTION E: CONCLUSION
The EUT is determined to meet the requirements as defined in the applicable regulations.

Appendix A: Model Variants

ACS Report: 15-0004.C08.1B
Report Revision: B
Report Issue Date: May 6, 2015

The same display is used on all models. Sonar components change values for the various models.. Sonar only models don't populate the GPS and SD circuitry.

HELIX 7x SONAR ,	**2dSonar Only**
HELIX 7x DI ,	**DI Sonar Only**
HELIX 7x SONAR GPS,	**2dSonar / GPS Combo**
HELIX 7x DI GPS,	**DI Sonar / GPS Combo**
HELIX 7x XD GPS ,	**XD Sonar / GPS Combo**
HELIX 7x SI GPS ,	**SI Sonar / GPS Combo**
HELIX 7x GPS,	**GPS Only**

For The Scope of Accreditation Under Lab Code 200612-0

Excellence in Compliance Testing

EMC Technical Report

Prepared For: Johnson Outdoors Marine Electronics, Inc

Model Covered: Helix 7 SI GPS
Model Variants: See Appendix A

In Accordance with:
Radio & Telecommunications
Terminal Equipment (R&TTE) Directive - 99/5/EC

Product Standard: EN 301 489-3 V1.6.1 with respect to
EN 301 489-1 V1.9.2

ACS Report: 15-0004.C09.3B
Report Revision: B
Report Issue Date: May 6, 2015

Project Manager:

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Reviewed by:

Forrest Duncan
EMC Department Manager
Advanced Compliance Solutions, Inc.

This report must not be used by the client to claim product certification, approval, or endorsement by NVLAP, NIST, or any agency of the Federal Government.

This report contains 42 pages

REVISION HISTORY Report Number: 15-0004.C09.3B Manufacturer: Johnson Outdoors Marine Electronics, Inc Model: Helix 7 SI GPS					
DATE	OLD REVISION	NEW REVISION	REASON	PAGES AFFECTED	APPROVED BY
February 6, 2015	---	A	Initial Release	All	Forrest Duncan
May 6, 2015	A	B	Revised model variants	42	Forrest Duncan

Project Information Sheet

ACS Project: 15-0004.C09.3B

Applicant Details

Manufacturer: Johnson Outdoors Marine Electronics, Inc
Street Address: 678 Humminbird Lane
City, State/Province and Postal Code: Eufaula, AL 36027
Country: USA
Contact: Tambryn Freund

Phone:
Fax:
Email: Tambryn.Freund@johnsonoutdoors.com

Sample Information

Model: Helix 7 SI GPS
Model Variant(s): See Appendix A
Environment of Use: Residential; Mounted on the main deck/consoles of small recreational vessels in an exposed environment.
Sample Receive Date: January 5, 2015
Sample Receive Condition: Good
Test Mode Description: GPS active, transducer active
Failure Mode (Provided by Mfg.): If the device fails to recover (i.e. GPS/Sonar Operation) upon reboot
Highest Data Rate: 266 MHz
Source: Microcontroller

Product Description

The HUMMINBIRD Helix 7 SI GPS is a fishfinder/GPS product with Side Imagine sonar capability to be used in the marine environment. It is comprised of a keyboard, LCD display, micro SD card slot, Internal GPS, transducer and power cable.

Test Information

Test Start Date: January 5, 2015
Test End Date: January 7, 2015
Emissions Pre-scan Site: SAC
Final Emissions Site: SAC
EMI Freq. Band: 150kHz - 6GHz
RFI Site: FAC
Radiated Emissions Equipment Class: Class B
Harmonic Current EMI Class: N/A

Test Methods Applied

(Check all that apply)

- ☒ CISPR 16-2-1 Ed. 1.1 2005
- ☒ CISPR 16-2-3 1st Ed. 2003
- ☒ IEC 61000-4-2 Ed. 2.0
- ☒ IEC 61000-4-3 Ed. 3.1
- ☒ IEC 61000-4-4 2nd Ed.
- ☐ IEC 61000-4-5 2nd Ed.
- ☒ IEC 61000-4-6 3rd Ed.
- ☐ IEC 61000-4-8 Ed. 1.1
- ☐ IEC 61000-4-11 2nd Ed.

Table of Contents

SECTION A: GENERAL INFORMATION

1.0 Introduction

1.1 Scope

This report documents conformance with the requirements set forth in EN 301 489-3 V1.6.1 with respect to EN 301 489-1 V1.9.2 and details the results of testing performed on January 5, 2015 through January 7, 2015 on the model Helix 7 SI GPS manufactured by Johnson Outdoors Marine Electronics, Inc.

1.2 Purpose

Testing was performed to evaluate the EUT with regard to EMC regulatory requirements in accordance with the European Unions CE Marking arrangements.

1.3 Results Summary

Product Standard or Test Method Applied	Description	Result
Product Standards		
EN 301 489-3 V1.6.1	Electromagnetic Compatibility (EMC) standard for radio equipment and services	Pass
EN 61000-3-2:2006 w/A1:2009 and A2:2009	Electromagnetic compatibility (EMC) -- Part 3-2: Limits - Limits for harmonic current emissions (equipment input current <= 16 A per phase)	N/A
EN 61000-3-3:2008	Electromagnetic compatibility (EMC) - Part 3-3: Limits - Limitation of voltage changes, voltage fluctuations and flicker in public low-voltage supply systems, for equipment with rated current <= 16 A per phase and not subject to conditional connection	N/A
Basic Immunity Standards per EN 301 489-3 V1.6.1		
IEC 61000-4-2 Ed. 2.0	Electromagnetic compatibility (EMC) - Part 4-2: Testing and measurement techniques - Electrostatic discharge immunity test	Pass
IEC 61000-4-3 Ed. 3.2	Electromagnetic compatibility (EMC) - Part 4-3: Testing and measurement techniques - Radiated, radio-frequency, electromagnetic field immunity test	Pass
IEC 61000-4-4 Ed. 3.0	Electromagnetic compatibility (EMC) - Part 4-4: Testing and measurement techniques - Electrical fast transient/burst immunity test	Pass
IEC 61000-4-5 2nd Ed.	Electromagnetic compatibility (EMC) - Part 4-5: Testing and measurement techniques - Surge immunity test	N/A
IEC 61000-4-6 3rd Ed.	Electromagnetic compatibility (EMC) - Part 4-6: Testing and measurement techniques - Immunity to conducted disturbances, induced by radio-frequency fields	Pass
IEC 61000-4-8 2nd Ed.	Electromagnetic compatibility (EMC) - Part 4-8: Testing and measurement techniques - Power frequency magnetic field immunity test	N/A
IEC 61000-4-11 2nd Ed.	Electromagnetic compatibility (EMC) - Part 4-11: Testing and measurement techniques - Voltage dips, short interruptions and voltage variations immunity tests	N/A

N/A = Not Applicable

1.4 Performance Criteria

1.4.1 Emissions Performance Criteria

For model Helix 7 SI GPS the limits which apply are shown in Table 1.4.1-1 below:

Table 1.4.1-1 Emissions Limits Class B

Emission Type	Frequency Range (MHz)	Quasi-Peak/Peak[4] Limits	Average Limits
Conducted Class B (Mains Port) (dBµV)	0.15 to 0.50	66 to 56[1]	56 to 46[1]
	0.50 to 5.00	56	46
	5.00 to 30.0	60	50
Conducted Class B (Telecom Ports)	0.15 to 0.50	84 to 74 (V)[1,2] 40 to 30 (I)[1,3]	74 to 64 (V)[1,2] 30 to 20 (I)[1,3]
	0.50 to 30	87 (V)[2] 43 (I)[3]	74 (V)[2] 30 (I)[3]
Radiated Class B at 3 Meters (dBµV/m)	30.0 to 230.0	40.5	
	230.0 to 1000.0	47.5	
	1000 to 3000	70	50
	3000 to 6000	74	54

1 - Decreases Linearly with Logarithm of Frequency **Note: Lower Limit Applies at Transition Frequency**
2 – (V) Indicates voltage limits in dBµV
3 – (I) Indicates current limits in dBµA
4 – Limits <1GHz are Quasi-Peak and Peak >1GHz

1.4.4 Immunity Performance Criteria

EN 301 489-3

EN 301 489-3 defines equipment into three types based on the technical nature of the primary function of the EUT. They are defined below:

Table 1.4.2-1: Equipment Type Description

Equipment Type	Technical nature of the primary function
I	Transfer of messages (digital or analogue signals)
II	Transfer of audio (speech or music)
III	Others

Further, the product family of Short Range Devices (SRD) is divided into three classes of equipment, each having its own set of minimum performance criteria. This classification is based upon the impact on persons and/or goods in case the equipment does not operate above the specified minimum performance level under EMC stress. The different classifications are given below.

Table 1.4.2-2: SRD Classification

Class of SRD Equipment	Risk assessment of receiver performance
1	Highly reliable SRD communication media; e.g. serving human life inherent systems (may result in a physical risk to a person)
2	Medium reliable SRD communication media; e.g. causing inconvenience to persons, which cannot simply be overcome by other means
3	Standard reliable SRD communication media; e.g. inconvenience to persons, which can simply be overcome by other means (e.g. manual)

Each immunity test requires 1 of 3 performance criteria to be met depending on the classification of the SRD. The performance criteria are:

- performance criteria A for immunity tests with phenomena of a continuous nature (CT);
- performance criteria B for immunity tests with phenomena of a transient nature (TT);
- performance criteria for immunity tests with power interruptions exceeding a certain time are handled on a case-by-case basis. See the specific test criteria for each test

The equipment shall meet the minimum performance criteria as specified by the following:

Table 1.4.2-3: Performance Table

Class 1 SRD equipment		
Criteria	**During test**	**After test**
A	Operate as intended No loss of function For equipment type II the minimum performance shall be 12 dB SINAD No unintentional responses	Operate as intended For equipment type II the communication link shall be maintained No loss of function No degradation of performance No loss of stored data or user programmable functions
B	May be loss of function (one or more) No unintentional responses	Operate as intended Lost function(s) shall be self-recoverable No degradation of performance No loss of stored data or user programmable functions
Class 2 SRD equipment		
Criteria	**During test**	**After test**
A	Operate as intended No loss of function For equipment type II the minimum performance shall be 6 dB SINAD No unintentional responses	Operate as intended For equipment type II the communication link shall be maintained No loss of function No degradation of performance No loss of stored data or user programmable functions
B	May be loss of function (one or more) No unintentional responses	Operate as intended Lost function(s) shall be self-recoverable No degradation of performance No loss of stored data or user programmable functions
Class 3 SRD equipment		
Criteria	**During test**	**After test**
A and B	May be loss of function (one or more) No unintentional responses	Operate as intended, for equipment type II the communication link may be lost, but shall be recoverable by user No degradation of performance Lost functions shall be self-recoverable

Performance criteria for Continuous phenomena applied to Transmitters (CT)
For equipment of type I or II including ancillary equipment tested on a stand alone basis, the performance criteria A of the applicable class as given in table 1.5.4-1 shall apply.

For equipment of type II or type III that requires a communication link that is maintained during the test, it shall be verified by appropriate means supplied by the manufacturer that the communication link is maintained during each individual exposure in the test sequence.

Where the EUT is a transmitter, tests shall be repeated with the EUT in standby mode to ensure that any unintentional transmission does not occur.

Performance criteria for Transient phenomena applied to Transmitters (TT)
For equipment of type I or II, including ancillary equipment tested on a stand alone basis, the performance criteria B of the applicable class as given in table 1.5.4-1 shall apply, except for power interruptions exceeding a certain time the performance criteria deviations are specified in section 13.3.1.
For equipment of type II or type III that requires a communication link that is maintained during the test, this shall be verified by appropriate means supplied by the manufacturer during each individual exposure in the test sequence.

Where the EUT is a transmitter, tests shall be repeated with the EUT in standby mode to ensure that any unintentional transmission does not occur.

Performance criteria for Continuous phenomena applied to Receivers (CR)
For equipment of type I or II, including ancillary equipment tested on a stand alone basis, the performance criteria A of the applicable class as given in table 1.5.4-1 shall apply.

For equipment of type II or III that requires a communication link that is maintained during the test, it shall be verified by appropriate means supplied by the manufacturer that the communication link is maintained during each individual exposure in the test sequence.

Where the EUT is a transceiver, under no circumstances shall the transmitter operate unintentionally during the test.

Performance criteria for Transient phenomena applied to Receivers (TR)
For equipment of type I or II, including ancillary equipment tested on a stand alone basis, the performance criteria B of the applicable class as given in table 1.5.4-1 shall apply, except for power interruptions exceeding a certain time the performance criteria deviations are specified in section 13.3.1

For equipment of type II or type III that requires a communication link that is maintained during the test, this shall be verified by appropriate means supplied by the manufacturer during each individual exposure in the test sequence.

Where the EUT is a transceiver, under no circumstances shall the transmitter operate unintentionally during the test.

2.0 Test Facilities & Environment

2.1 Test Facilities

All testing was performed at the following address:

Advanced Compliance Solutions, Inc.
5015 B.U. Bowman Drive
Buford GA 30518
Phone: (770) 831-8048
Fax: (770) 831-8598
www.acstestlab.com

The laboratory is fully equipped to carry out the tests outlined in section 1.0

2.2 Laboratory Accreditations/Recognitions/Certifications

ACS is accredited to ISO/IEC 17025 by the National Institute of Standards and Technology under their National Voluntary Laboratory Accreditation Program (NVLAP). Unless otherwise specified, all tests methods described within this report are covered under the ISO/IEC 17025 scope of accreditation.

2.3 Test Environment

Unless otherwise specified by the generic or product standard, the EUT was evaluated within the climate conditions of the EUT as specified by the manufacturer.

Where the manufacturer does not specify climate parameters for the EUT, all test are performed within the climate parameters given below:

- Ambient temperature 15° to 35° C
- Relative Humidity 30% to 60%
- Atmospheric Pressure 860mbar to 1060mbar

All test equipment was operated within climate specifications as defined by the manufacturer.

2.4 Test Equipment Calibration Statement

Test equipment used for each test is specified in the relevant sections of this test report. Unless expressly given, all test equipment is calibrated on an annual basis, where applicable. All test equipment is operated within the climate specifications as defined by the manufacturer.

3.0 Equipment Under Test (EUT)

3.1 Manufacturer

Johnson Outdoors Marine Electronics, Inc
678 Humminbird Lane
Eufaula, AL 36027
Tambryn Freund
Tambryn.Freund@johnsonoutdoors.com

3.2 Modifications

Table 3.2-1 below describes any modification required to bring the EUT into compliance with the test standard. Photographs of the modifications, if any, are contained in appendix a.

Table 3.2-1: EUT Modifications

☒ **Modifications were not required to bring the EUT into compliance with the requirements.** ☐ **Modifications were required to bring the EUT into compliance with the requirements.**

3.3 System Block Diagram and Support Equipment

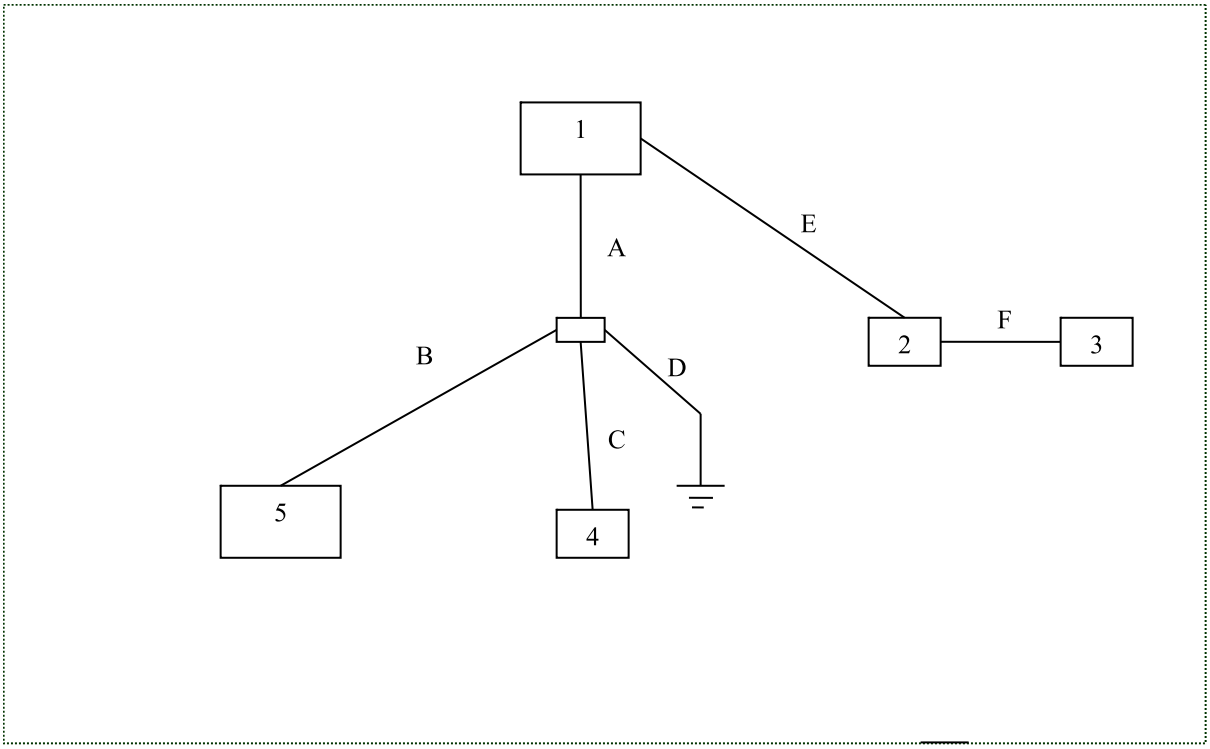


Figure 3.3-1: System Block Diagram

Table 3.3-1: EUT and Support Equipment Description

Item #	Type Device	Manufacturer	Model/Part #	Serial #
1	EUT	Johnson Outdoors	Helix 7 SI GPS	14121724-0001
2	Transducer	Johnson Outdoors	N/A	N/A
3	Depth Simulator	Johnson Outdoors	N/A	N/A
4	GPS Antenna	Humminbird	AS GR50 GPS module	10102742-0165
5	12Vdc Battery	AUTOCRAFT	M24-1	N/A

Table 3.3-2: Cable Description

Cable #	Cable Type	Length	Shield	Termination
A	Signal cable	1m	No	1 - junction
B	Power cable	1.8m	No	5 - junction
C	Signal cable	6m	No	4 - junction
D	Ground braid	1m	No	Junction - ground
E	Transducer cable	6m	No	1 - 2
F	Transducer cable	1m	No	2 - 3

3.4 Observations

Any general observations regarding any part of the evaluation are given in table 3.4-1.

Table 3.4-1: Observations

Observation No.	Description

SECTION B: EMISSIONS – TEST INFORMATION AND RESULTS

4.0 Radiated and Conducted Emissions

4.1 Radiated Emissions

4.1.1 Test Site Description

4.1.1.1 Open Area Test Site

The open area test site consists of a 40' x 66' concrete pad covered with a perforated electro-plated galvanized sheet metal. The perforations in the sheet metal are 1/8" holes that are staggered every 3/16". The individual sheets are placed to overlap each other by 1/4" and are riveted together to provide a continuous seam. Rivets are spaced every 3" in a 3 x 20 meter perimeter around the antenna mast and EUT area. Rivets in the remaining area are spaced as necessary to properly secure the ground plane and maintain the electrical continuity.

The entire ground plane extends 12' beyond the turntable edge and 16' beyond the antenna mast when set to a 10 meter measurement distance. The ground plane is grounded via 4 - 8' copper ground rods, each installed at a corner of the ground plane and bound to the ground plane using 3/4" stainless steel braided cable.

The turntable is an all aluminum 10' flush mounted table installed in an all aluminum frame. The table is remotely operated from inside the control room located 40' from the range. The turntable is electrically bonded to the surrounding ground plane via steel fingers installed on the edge of the turn table. The steel fingers make constant contact with the ground plane during operation.

Adjacent to the turntable is a 7' x 7' square and 4' deep concrete pit used for support equipment if necessary. The pit is equipped with 5 - 4" PVC chases from the pit to the control room that allow for cabling to the EUT if necessary. The underside of the turntable can be accessed from the pit so cables can be supplied to the EUT from the pit. The pit is covered with 2 sheets of 1/4" diamond style re-enforced steel sheets. The sheets are painted to match the perforated steel ground plane; however the underside edges have been masked off to maintain the electrical continuity of the ground plane. All reflecting objects are located outside of the ellipse defined in ANSI C63.4.

A diagram of the Open Area Test Site is shown in Figure 4.1.1.1-1 below:

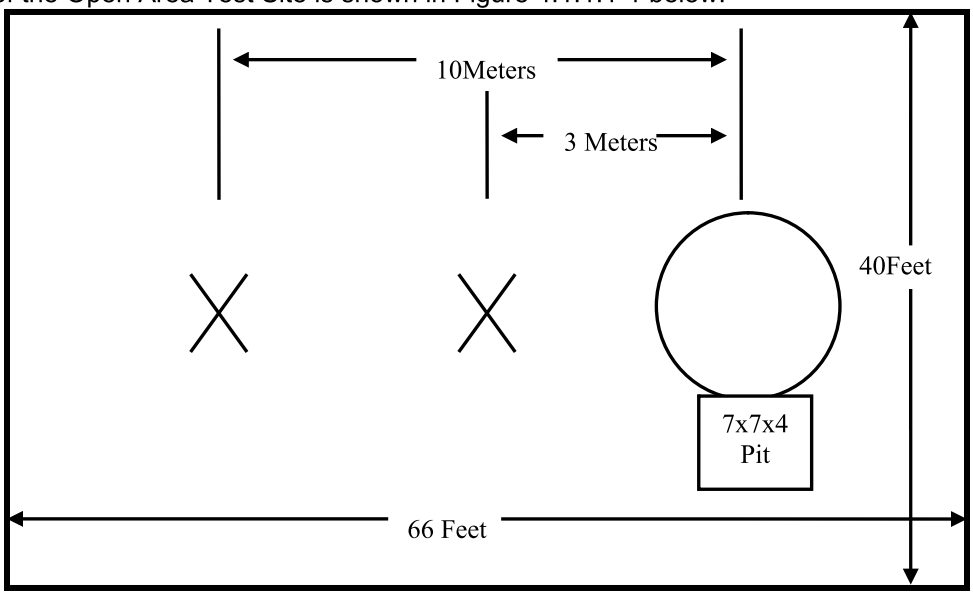


Figure 4.1.1.1-1: Open Area Test Site

4.1.1.2 Semi-Anechoic Chamber

The Semi-Anechoic Chamber Test Site consists of a 20' x 30' x 18' shielded enclosure. The chamber is lined with Toyo Ferrite Grid Absorber, model number FFG-1000. The ferrite tile grid is 4" x 4" x ¾" thick and weighs approximately 1.4lbs. These tiles are mounted on steel panels and installed directly on the inner walls of the chamber.

The turntable is 150cm in diameter and is located 160cm from the back wall of the chamber. The chamber is grounded via 1 - 8' copper ground rod, installed at the center of the back wall, it is bound to the ground plane using 3/4" stainless steel braided cable. The turntable is all steel, flush mounted table installed in an all steel frame. The table is remotely operated from inside the control room located 25' from the turntable. The turntable is electrically bonded to the surrounding ground plane via steel fingers installed on the edge of the turn table. The steel fingers make constant contact with the ground plane during operation.

Behind the turntable is a 3' x 6' x 4' deep shielded pit used for support equipment if necessary. The pit is equipped with 1 - 4" PVC chase from the turntable to the pit that allow for cabling to the EUT if necessary. The underside of the turntable can be accessed from the pit so cables can be supplied to the EUT from the pit.

To comply with the requirements of the test methods given on page 3, RF absorbing foam was placed inside the chamber in a configuration that provided the best results. First, an 8 ft. patch of 12" tall absorber was placed on the floor between the turntable and the receiving antenna. This absorber meets the absorption requirements specified in ANSI C63.4:2009. Next, three vertical structures (Fences) were created and covered with 8" pyramidal RF absorbing foam, two 4 ft. x 4 ft. and one 6 ft. x 4 ft. These fences were placed at locations to prevent high energy signals from reaching the back chamber wall and reflecting back to the receive antenna.

A diagram of the Semi-Anechoic Chamber Test Site is shown in Figure 4.1.1.2-1 below:

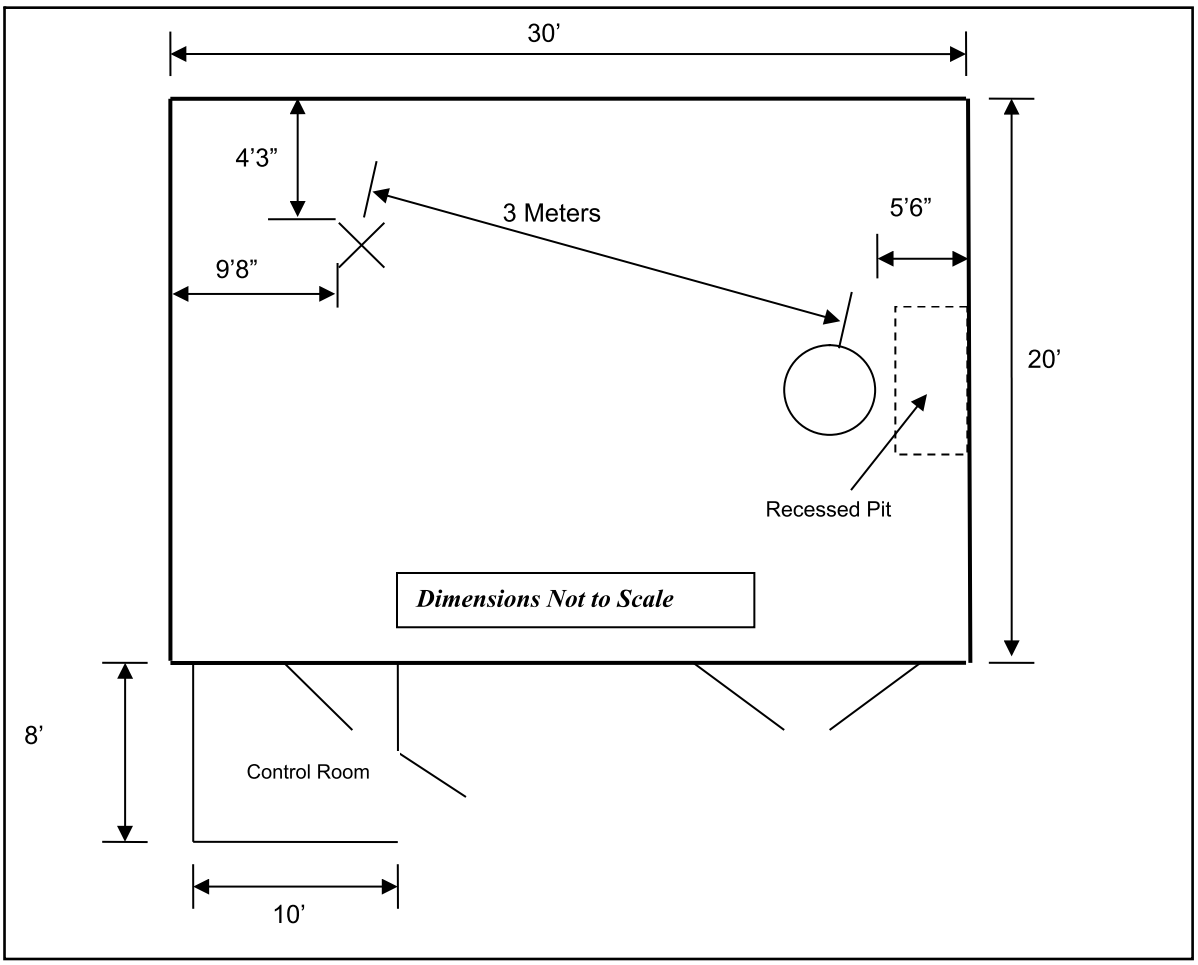


Figure 4.1.1.2-1: Semi-Anechoic Chamber Test Site

4.1.1.3 Fully Anechoic Chamber

The 3m fully anechoic chamber is used for pre-screening the EUT for emissions only. Final screening is performed on the OATS or in case of Class B EUT's, in the 3m semi-anechoic chamber. The Fully Anechoic Chamber has been characterized for field uniformity in accordance with IEC 61000-4-3 and can be used for final radiated fields immunity testing.

The Fully-Anechoic Chamber Test Site consists of a 24'L x 16'W x 12'H shielded enclosure. The chamber is fully lined with RF absorbing foam. The foam ranges in type from 8-24" conventional pyramidal cones, 8-12" conventional wedges and 6" and 16" Hybrid Foam over ferrite tile. The Hybrid material is placed in the 6 specular regions of the chamber for better low-frequency performance. The specular regions are 1) directly behind the receiving antenna, 2) on the floor between the receiving antenna and the EUT table, 3) the wall directly behind the EUT, 4&5) the side walls between the receiving antenna and the EUT table and 6) the ceiling between the receiving antenna and the EUT. The specular regions are 6' x 4' in size.

The chamber is grounded via 1 - 8' copper ground rod, installed at the center of the back wall, it is bound to the shield using 3/4" stainless steel braided cable.

The turntable is a remotely controlled EMCO Model 1060 and is 150cm in diameter and is located 1m from the absorber on the back wall of the chamber.

A diagram of the Fully Anechoic Chamber Test Site is shown in Figure 4.1.1.3-1 below:

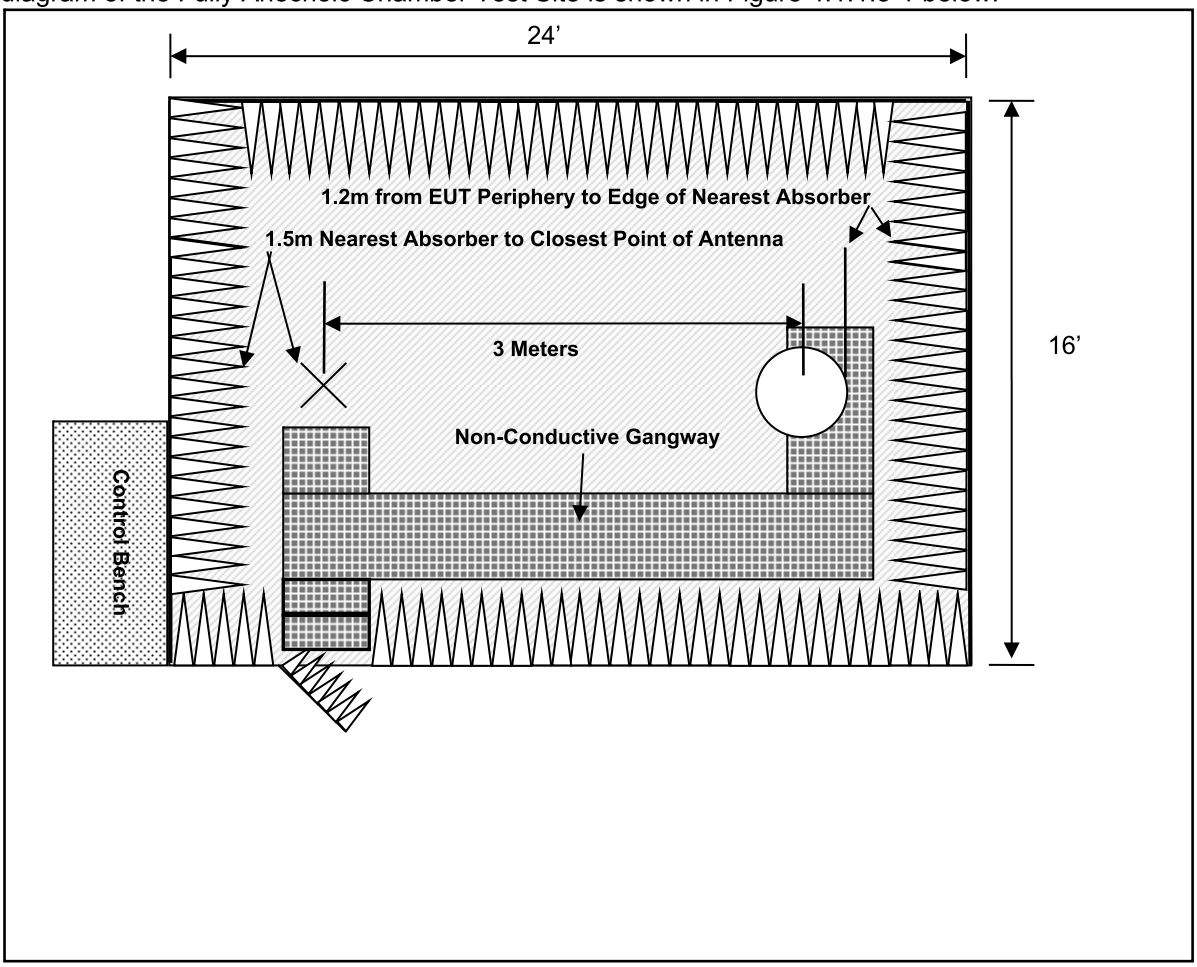


Figure 4.1.1.3-1: Fully Anechoic Chamber Test Site

4.1.2 Test Equipment

Table 4.1.2-1 identifies all equipment used for radiated emissions respectively.

Table 4.1.2-1 Test Equipment – Radiated Emissions

AssetID	Manufacturer	Model #	Equipment Type	Serial #	Last Calibration Date	Calibration Due Date
1	Rohde & Schwarz	ESMI - Display	Spectrum Analyzers	833771/007	7/11/2014	7/11/2015
2	Rohde & Schwarz	ESMI-Receiver	Spectrum Analyzers	839587/003	7/11/2014	7/11/2015
73	Agilent	8447D	Amplifiers	2727A05624	7/15/2014	7/15/2015
338	Fluke	8010A	Meters	3385330	NCR	NCR
204	ACS	204	Cables	204	NCR	NCR
167	ACS	Chamber EMI Cable Set	Cable Set	167	10/28/2014	10/28/2015
628	EMCO	6502	Antennas	9407-2877	2/7/2014	2/7/2016
40	EMCO	3104	Antennas	3211	2/14/2013	2/14/2015
412	Electro Metrics	LPA-25	Antennas	1241	7/24/2014	7/24/2016

NCR = No Calibration Required

4.1.3 Test Methodology

4.1.3.1 Pre-Scans

Radiated pre-scans are performed on all EUT's in either the 3m Semi-Anechoic or the 3m Fully-Anechoic Chamber. Final emission testing for Class A equipment is performed on the 3/10m Open Area Test Site (OATS) as described in section 4.1.1. Final emission testing on Class B equipment can be performed either in the 3m Semi-Anechoic chamber described in section 4.1.2 or on the OATS.

Pre-scans are a method by which the 10 highest emissions can be identified for final evaluation. This is achieved by taking automated emission snapshots of the EUT at various azimuths and antenna heights. The software is programmed to perform a peak sweep of the band using the maxhold function. This sweep is performed every 90º in both horizontal and vertical polarities and at antenna heights of 100cm and 300cm. Although not a fully maximized scan, the pre-scan gives a good indication of pass or fail.

4.1.3.2 Final Scans

Radiated emissions measurements were made over the frequency range of 30MHz – 2GHz. Quasi-Peak measurements are taken with the Spectrum Analyzer's resolution bandwidth was set to 120KHz and video bandwidth set to 300 kHz for measurements below 1000MHz. Average measurements above 1000MHz are taken using measurement instruments average detector. The calculation for the radiated emissions field strength is as follows:

Corrected Reading = Analyzer Reading + Cable Loss + Antenna Factor
Margin(dB) = Applicable Limit - Corrected Reading

4.1.3.3 Test Criteria

The EUT must meet the Class B Limits as given in section 1.4.1.

4.1.3.4 Test Justification

☒ **No justification - The EUT was tested per the appropriate test methods and test plan.**
☐ **The test method, standard, and/or test plan was deviated from for the following reason:**

4.1.4 Test Setup Photographs

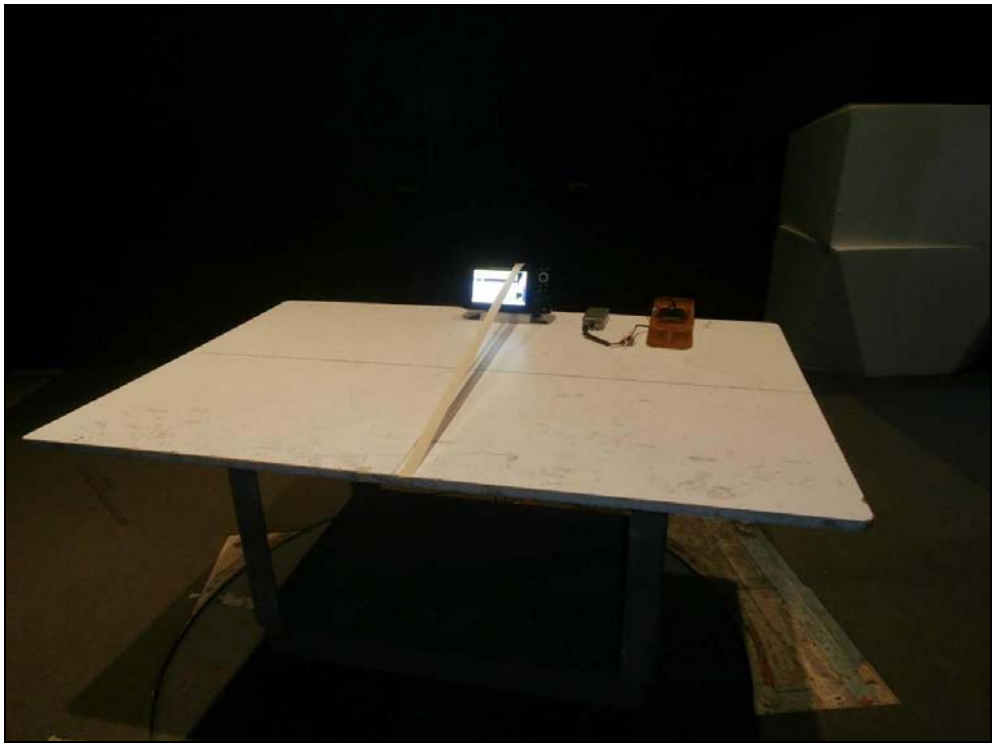


Figure 4.1.4-1: Radiated Emissions - Front View

Figure 4.1.4-2: Radiated Emissions - Rear View

4.1.5 Test Data

Final tabulated radiated emissions data are reported in the Test Data Table below:

Test Parameters:

Test Date:	**January 5, 2015**	**Temperature (ºC)**	**22**
Technician:	**Art Sumner**	**Humidity (%)**	**35**
Equipment Class:	**Class B**	**Barometric Pressure (mBar)**	**1031**
Tested Modes:	**Powered on; monitoring depth and speed**		
AC Input Power:	**N/A**		
DC Input Power:	**12Vdc**		

Test Data Table:

Measurement Distance:

☐ 1 Meter ☒ 3 Meter ☐ 10 Meter

Frequency (MHz)	Measured Level (dBuV)		Antenna Polarity (H/V)	Antenna Height (cm)	Turntable Position (o)	Correction Factors (dB)	Corrected Level (dBuV/m)		Limit (dBuV/m)		Margin (dB)	
	Pk	Qpk/Av					Pk	Qpk/Av	Pk	Qpk/Av	Pk	Qpk/Av
30.1	36.75	32.15	v	100	0	-13.22	---------	18.93	---------	40.5	---------	21.5
40.38	51.28	30.73	v	100	0	-14.69	---------	16.04	---------	40.5	---------	24.4
40.76	44.43	29.41	v	100	0	-14.68	---------	14.73	---------	40.5	---------	25.7
42.08	34.27	32.25	v	100	0	-14.66	---------	17.59	---------	40.5	---------	22.9
59.46	41.86	23.95	v	100	0	-14.03	---------	9.92	---------	40.5	---------	30.5
70.42	33.94	30.45	v	100	0	-17.03	---------	13.42	---------	40.5	---------	27.0
240	35.05	30.78	v	100	0	-13.50	---------	17.28	---------	47.5	---------	30.2
472.88	31.60	23.49	v	100	0	-6.08	---------	17.41	---------	47.5	---------	30.1
157.31	32.92	27.27	v	100	0	-10.68	---------	16.59	---------	40.5	---------	23.9

Qpk = Quasi-Peak Measurement or Limit (< 1GHz)
AV = Average Measurement or Limit (>1GHz)

Notes: No emissions of concern above 1GHz

4.2 Conducted Emissions

4.2.1 Test Justification

☐ No justification - The EUT was tested per the appropriate test methods and test plan.
☒ The test method, standard, and/or test plan was deviated from for the following reason:

The EUT is DC powered and does not include Telecommunication lines; therefore, this test is not applicable.

5.0 Harmonic Current Emissions

5.1 Test Justification

☐ **No justification - The EUT was tested per the appropriate test methods and test plan.**
☒ **The test method, standard, and/or test plan was deviated from for the following reason:**

This test is not applicable, because the EUT is not powered through an AC Mains power supply.

6.0 Voltage Fluctuations & Flicker

6.1 Test Justification

☐ **No justification - The EUT was tested per the appropriate test methods and test plan.**
☒ **The test method, standard, and/or test plan was deviated from for the following reason:**

This test is not applicable, because the EUT is not powered through an AC Mains power supply.

SECTION C: IMMUNITY – TEST INFORMATION AND RESULTS

7.0 Electrostatic Discharge Immunity

7.1 Test Site Description

The EUT was configured and connected to satisfy its functional requirements.

For a table top configuration, the EUT was placed on an insulating support of 0.5mm in the center of the Horizontal Coupling Plane (HCP). The HCP laid flat on a non-conductive table measuring 1.6 meters x 0.8 meters x 0.8 meters. The non-conductive table was placed on a 16 feet x 8 feet Ground Reference Plane (GRP). The Vertical Coupling Plane was placed 10cm from the EUT and insulated from the HCP.

For a floor standing configuration the EUT was placed on a 10cm insulated support. The non-conductive spacer was placed on a 16 feet x 8 feet Ground Reference Plane (GRP). The Vertical Coupling Plane was placed 10cm from the EUT.

Both the HCP and the VCP were connected to the GRP via cables with 470kΩ resistors located at each end. The ground lead of the ESD generator was also connected to the GRP.

7.2 Test Equipment

Table 7.2-1: Test Equipment List

AssetID	Manufacturer	Model #	Equipment Type	Serial #	Last Calibration Date	Calibration Due Date
582	Kikusui	KES4021A	ESD Gun	SA003046	2/20/2014	2/20/2015
144	Omega	RH411	Climate Monitoring Equipment	H0103373	7/24/2014	7/24/2016
RE80	Tektronix	TDS 784C	Oscilloscope	7846	7/30/2013	7/30/2015
371	Fluke	Fluke 115	Meters	93872717	7/10/2014	7/10/2016

NCR = No Calibration Required

7.3 Test Methodology

IEC 61000-4-2 - Electromagnetic compatibility (EMC) - Part 4. Testing and measurement techniques - Section 4.2 Electrostatic discharge immunity test - Basic EMC Publication, was the guiding document for this test. The purpose of this test is to verify the immunity of single devices or systems against electrostatic discharges (ESD) generated by an operator or object touching the equipment, or by objects or persons coming into contact in the vicinity of the equipment.

Only areas of the EUT that are accessible to the user are considered for the evaluation.

Direct Contact Discharge

Devices with accessible conductive surfaces are subject to direct contact discharges. Each test point identified was subjected to 10 discharges of both positive and negatives impulses.

Indirect Contact Discharge

The EUT was subjected to indirect contact discharges to a horizontal coupling plane (HCP). At least 10 single discharges in both polarities were applied to the EUT via the HCP on all sides and at a separation distance of 10cm. In addition the EUT was subjected indirect discharges to a vertical coupling plane (VCP). At least 10 single discharges in both polarities were applied to the EUT via the VCP on all sides and at a separation distance of 10cm.

Air Discharge

Insulated surfaces of the EUT that are accessible were subjected to air discharges. Each test point is subjected to 10 discharges of each polarity.

7.3.1 Test Criteria

EN 301 489-3 V1.6.1 requires performance criterion B to be met as described in section 1.4.2.

7.3.2 Test Justification

☒ No justification - The EUT was tested per the appropriate test methods and test plan.
☐ The test method, standard, and/or test plan was deviated from for the following reason:

7.4 Test Setup Photograph

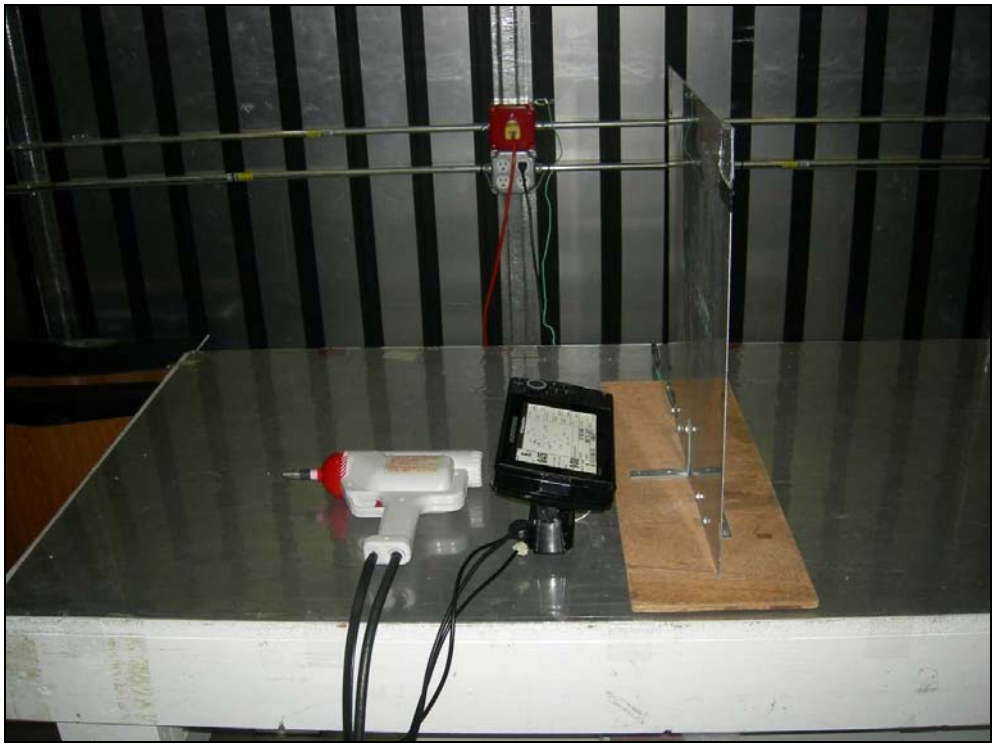
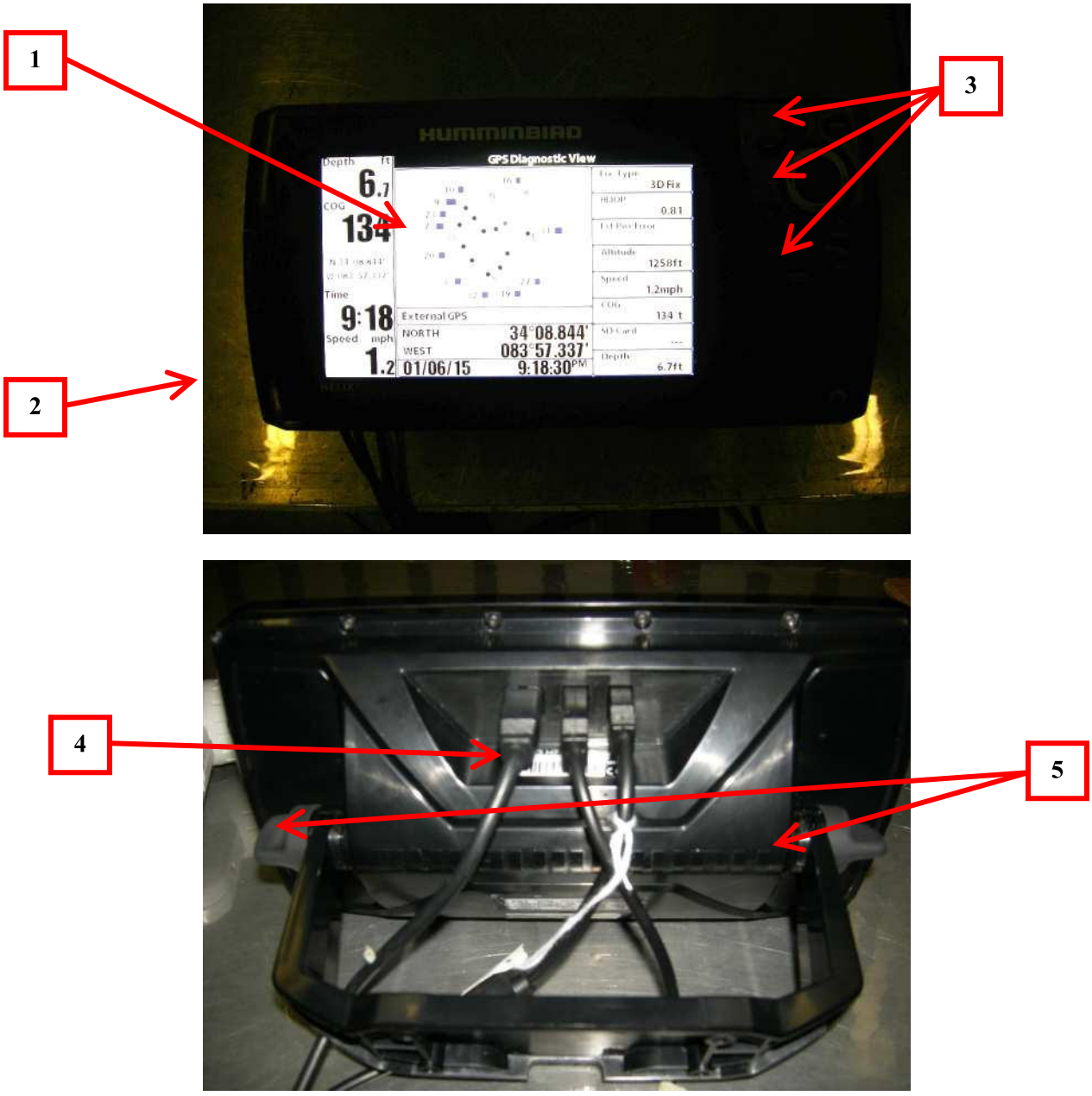


Figure 7.4-1: Test Setup Photograph

7.5 ESD Data Sheet

Test Point Photograph:



Test Point Selection:

TEST POINT#	DESCRIPTION	TYPE (C/A)	TEST POINT#	DESCRIPTION	TYPE (C/A)
1	Display screen center and edges	**Air**	4	Molded connectors and cables	**Air**
2	Cabinet edges and seem	**Air**	5	Mounting knob	**Air**
3	Buttons	**Air**			

7.6 Test Data

Test Parameters:

Test Date:	January 6, 2015	Temperature (ºC)	21
Technician:	Wayne Orwig	Humidity (%)	34
Equipment Class:	N/A	Barometric Pressure (mBar)	1022
Tested Modes:	GPS and transducer active		
AC Input Power:	N/A	VCP Resistor Value Check:	949k ohms
DC Input Power:	12Vdc Battery	HCP Resistor Value Check:	936k ohms

Indirect Contact Discharge:

Check All That Apply to This Data

Plane:	Polarity:	Tested Levels:	
☐ Vertical Coupling Plane	☐ Positive	☒ 2kV	☐ 8kV
☐ Horizontal Coupling Plane	☐ Negative	☒ 4kV	☐ 15kV
☒ Both	☒ Both	☒ 6kV	☐ Enter Other Level Here

Side	Result	Observation (Describe any detectable event)
Front	Pass	
Rear	Pass	
Left	Pass	
Right	Pass	
Bottom	Pass	

Notes:

Air and Direct Contact Discharge:

Check All That Apply to This Data

Polarity:	Tested Levels:	
☐ Positive	☒ 2kV	☒ 8kV
☐ Negative	☒ 4kV	☐ 15kV
☒ Both	☐ 6kV	☐ Enter Other Level Here

Test Point	Discharge Type	Result	Observation (Describe any detectable event)
1	Air	Pass	
2	Air	Pass	
3	Air	Pass	
4	Air	Pass	
5	Air	Pass	

Notes:

8.0 Radio-Frequency Electromagnetic Fields

8.1 Test Site Description

The radiated fields test was performed in the semi or fully-anechoic chamber described in section 4.1.1.2 or 4.1.1.3 respectively.

8.2 Test Equipment

Table 8.2-1: Test Equipment List

AssetID	Manufacturer	Model #	Equipment Type	Serial #	Last Calibration Date	Calibration Due Date
251	Rohde & Schwarz	SML03	Signal Generators	102116	10/30/2014	10/30/2015
329	A.H.Systems	SAS-571	Antennas	721	7/15/2013	7/15/2015
370	IFI	CMX5002	Amplifier	L364-0407	NCR	NCR
642	Fairview Microwave	FMC0101951-200CM	Cables	N/A	NCR	NCR
326	ACS	EMI Cable Set-FAC	Cables	326	7/18/2014	7/18/2015
354	ETS Lindgren	3142C	Antennas	78838	NCR	NCR
1112	Wandel & Goltermann	BN2244/21	Probes	H0006	11/11/2014	11/11/2015
1201	Wandel & Goltermann	2244/99.22	Probes	W-0004	11/11/2014	11/11/2015
494	Omega	iBTHX-W	Climate Monitoring Equipment	9460211	8/12/2014	8/12/2016
RE89	Amplifier Research	25S1G4A	Amplifiers	324609	NCR	NCR
564	United Microwave Products, Inc.	AO-190-00.36.0	Cables	564	7/18/2014	7/18/2015

NCR = No Calibration Required

8.3 Test Methodology

IEC 61000-4-3 Ed. 3.1- Electromagnetic compatibility (EMC) - Part 4. Testing and measurement techniques - Section 3: Radiated, radio-frequency, electromagnetic field immunity test, was the guiding document for this test. The purpose of this test is to verify the immunity of single devices or systems when subjected to radio-frequency electromagnetic field.

The EUT was configured and connected to satisfy its functional requirements. One representative sample was placed on the table and rotated 90° to expose all side of the EUT to the radiofrequency electromagnetic field. The table is non-conductive measuring 1.5 meters x 1.0 meters x 0.8 meters. The non-conductive table was placed 3 meters from the radiating antenna.

The frequency ranges to be considered are swept with the signal 80% amplitude modulated with a 1kHz AM sine wave, pausing to adjust the RF signal level or to switch oscillators and antennas as necessary. Where the frequency range is swept incrementally, the step size shall not exceed 1% of fundamental with linear interpolation between calibrated points.

The test shall normally be performed with the generating antenna facing each of the four sides of the EUT, however if the equipment can be used in different orientations, the test shall be performed on all sides, 6 total.

The polarization of the field generated by each antenna necessitates testing each side twice, once with the antenna positioned vertically and again with the antenna positioned horizontally.

8.3.1 Test Criteria

EN 301 489-3 V1.6.1 requires criterion A to be met as described in section 1.4.2.

8.3.2 Test Justification

☒ **No justification - The EUT was tested per the appropriate test methods and test plan.**
☐ **The test method, standard, and/or test plan was deviated from for the following reason:**

8.4 Test Setup Photographs

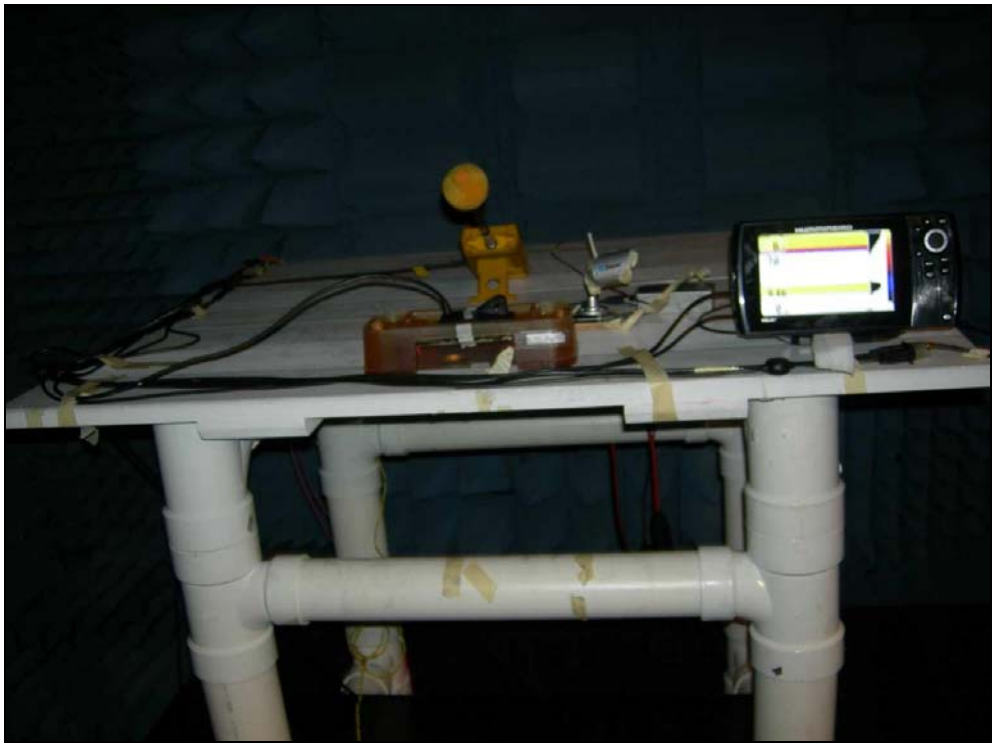


Figure 8.4-1: Test Setup Photograph

8.5 Test Results

Test Parameters:

Test Date:	**January 5, 2015**	**Temperature (ºC)**	**22.3**
Technician:	**Sean Vick**	**Humidity (%)**	**32.7**
Equipment Class:	**N/A**	**Barometric Pressure (mBar)**	**1028**
Tested Modes:	**EUT on; Monitoring Depth; Temp; Speed; GPS**		
AC Input Power:	**N/A**	☒ **Pre-test Verification Complete**	
DC Input Power:	**12Vdc**		

Test Data:

Check All That Apply to This Data

Polarity	Field Strength:	Freq. Band:	Dwell Time
☐ Horizontal	☒ 3V/m	☒ 80-1000MHz	☐ 1 Second
☐ Vertical	☐ 10V/m	☐ 80-2700MHz	☒ 3 Seconds
☒ Both	☐ 8V/m	☒ 1.4GHz - 2.7GHz	☐ Enter Other
	☐ Enter Other Level Here		

Azimuth	Result	Observation (Describe any detectable event)
0	Pass	
90	Pass	
180	Pass	
270	Pass	

Notes:

9.0 Electrical Fast Transient/Bursts

9.1 Test Site Description

The EUT was configured and connected to satisfy its functional requirements. The EUT was placed in the center of a non-conductive support measuring 125cm x 96cm x 10 cm. The non-conductive support is placed on a 8 feet x 8 feet Ground Reference Plane (GRP). A minimum distance of 50 cm between the EUT and all other conductive structures was maintained. A minimum distance of 50 cm between the coupling clamp and all other conductive structures, except the GRP, was maintained. A 10 cm insulated support was placed between the capacitive coupling clamp and the GRP. The GRP was bonded to the EFT/B generator.

The input power port of the EUT was tested using the coupling/decoupling network. The +/-1kV bursts were applied to all lines individually as well as simultaneously.

The bursts were applied to the signal/control line ports, if present, using the capacitive coupling clamp.

9.2 Test Equipment

Table 9.2-1: Test Equipment List

AssetID	Manufacturer	Model #	Equipment Type	Serial #	Last Calibration Date	Calibration Due Date
62	Haefely Trench	EFT Clamp	Immunity Equipment	None	10/2/2014	10/2/2015
474	Keytek	EMC PRO	General Lab Equipment	9808246	10/2/2014	10/2/2015
494	Omega	iBTHX-W	Climate Monitoring Equipment	9460211	8/12/2014	8/12/2016
336	Tektronix	TDS 1012B	Scopes	C010189	7/12/2014	7/12/2015
611	Teseq	INA 265B	Attenuators	73054	9/12/2013	9/12/2015
503	Key Tek	TC-50	Cables	n/a	12/30/2014	12/30/2015

NCR = No Calibration Required

9.3 Test Methodology

IEC 61000-4-4 2nd Ed. - Electromagnetic compatibility (EMC) - Part 4. Testing and measurement techniques - Section 4: Electrical fast transient/burst immunity test - Basic EMC Publication., was the guiding document for this test. The purpose of this test is to verify the immunity of single devices or systems when subjected to types of transient disturbances such as those originating from switching transients such as interruption of inductive loads or relay contact bounce.

9.3.1 Test Criteria

EN 301 489-3 V1.6.1 requires criterion B to be met as described in section 1.4.2.

9.3.2 Test Justification

☒ **No justification - The EUT was tested per the appropriate test methods and test plan.**
☐ **The test method, standard, and/or test plan was deviated from for the following reason:**

9.4 Test Setup Photographs

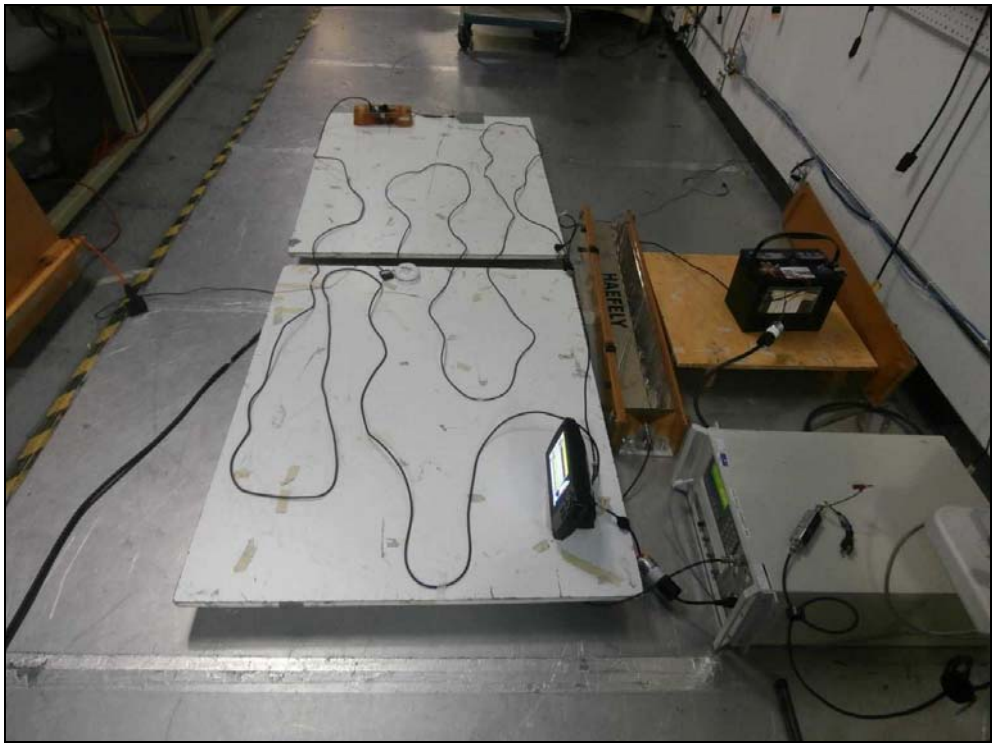


Figure 9.4-1: Test Setup Photograph

Figure 9.4-2: Test Setup Photograph

9.5 Test Results

Test Parameters:

Test Date:	**January 6, 2015**	**Temperature (ºC)**	**22**
Technician:	**Wayne Orwig**	**Humidity (%)**	**30**
Equipment Class:	**N/A**	**Barometric Pressure (mBar)**	**1022**
Tested Modes:	**GPS and transducer operating**		
AC Input Power:	**N/A**		
DC Input Power:	**12Vdc**		

Mains Test Data:

Check All That Apply to This Data

Polarity:	Tested Levels:	Interface Type:
☐ Positive	☒ .5kV	☒ Input
☐ Negative	☐ 1kV	☐ Output
☒ Both	☐ 2kV	☐ Both
	☐	

Coupling Mode	Result	Observation (Describe any detectable event)
L1	Pass	
L2	Pass	
L1-L2	Pass	

Notes:

Signal Line Test Data:

Check All That Apply to This Data

Polarity:	Tested Levels:
☐ Positive	☒ .25kV
☐ Negative	☒ .5kV
☒ Both	☐ 1kV
	☐ 2kV
	☐ Enter Other Level Here

Signal Line	Result	Observation (Describe any detectable event)
GPS cable	Pass	
Transducer cable	Pass	

Notes:

10.0 Surge Immunity

10.1 Test Justification

☐ No justification - The EUT was tested per the appropriate test methods and test plan.
☒ The test method, standard, and/or test plan was deviated from for the following reason:

This test is not applicable, because the EUT is not powered through an AC Mains power supply.

11.0 Radio-Frequency Common-Mode Immunity

11.1 Test Site Description

The EUT was configured and connected to satisfy its functional requirements. The EUT was placed on an insulating support of 0.1m height above a ground reference plane. All relevant cables were provided with the appropriate coupling and decoupling devices at a distance between 0.1m and 0.3m from the projected geometry of the EUT on the Ground Reference Plane (GRP).

11.2 Test Equipment

Table 11.2-1: Test Equipment List

AssetID	Manufacturer	Model #	Equipment Type	Serial #	Last Calibration Date	Calibration Due Date
370	IFI	CMX5002	Amplifier	L364-0407	NCR	NCR
251	Rohde & Schwarz	SML03	Signal Generators	102116	10/30/2014	10/30/2015
425	ACS	EMC Cable Set	Cable Set	425	NCR	NCR
642	Fairview Microwave	FMC0101951-200CM	Cables	N/A	NCR	NCR
624	Advantest	R3261C	Spectrum Analyzers	31720426	NCR	NCR
471	Bird Technologies Group	150-A-FFN-06	Attenuators	914	NCR	NCR
457	Com Power	CDN-M2-25	Coupler	511023	10/29/2014	10/29/2015
364	Amplfier Research	DC2600A	Coupler	322466	NCR	NCR
181	COM-POWER	m1-25	CDN's	501001	NCR	NCR
93	Chase	8101	Clamp	65	5/7/2014	5/7/2015

NCR = No Calibration Required

11.3 Test Methodology

IEC 61000-4-6 3rd Ed. - Electromagnetic compatibility (EMC) - Part 4: Testing and measurement techniques - Section 6: Immunity to conducted disturbances, induced by radio- frequency fields, was the guiding document for this test. The purpose of this test is to verify the immunity of single devices or systems when subjected to radio-frequency electromagnetic field.

The EUT was caused to operate as intended and monitored for changes in performance. The frequency range is swept from 150 kHz to 80MHz, using the signal levels established during the setting process, and with the disturbance signal 80% amplitude modulated with a 1kHz AM sine wave, pausing to adjust the RF signal level or to switch coupling devices as necessary. The rate of sweep shall not exceed 1.5 x 10^{-3} decades. Where the frequency is swept incrementally, the step size shall not exceed 1% of the start and thereafter 1% of the preceding frequency value.

11.3.1 Test Criteria

EN 301 489-3 V1.6.1 requires criterion A to be met as described in section 1.4.2.

11.3.2 Test Justification

☒ **No justification - The EUT was tested per the appropriate test methods and test plan.**
☐ **The test method, standard, and/or test plan was deviated from for the following reason:**

11.4 Test Setup Photographs

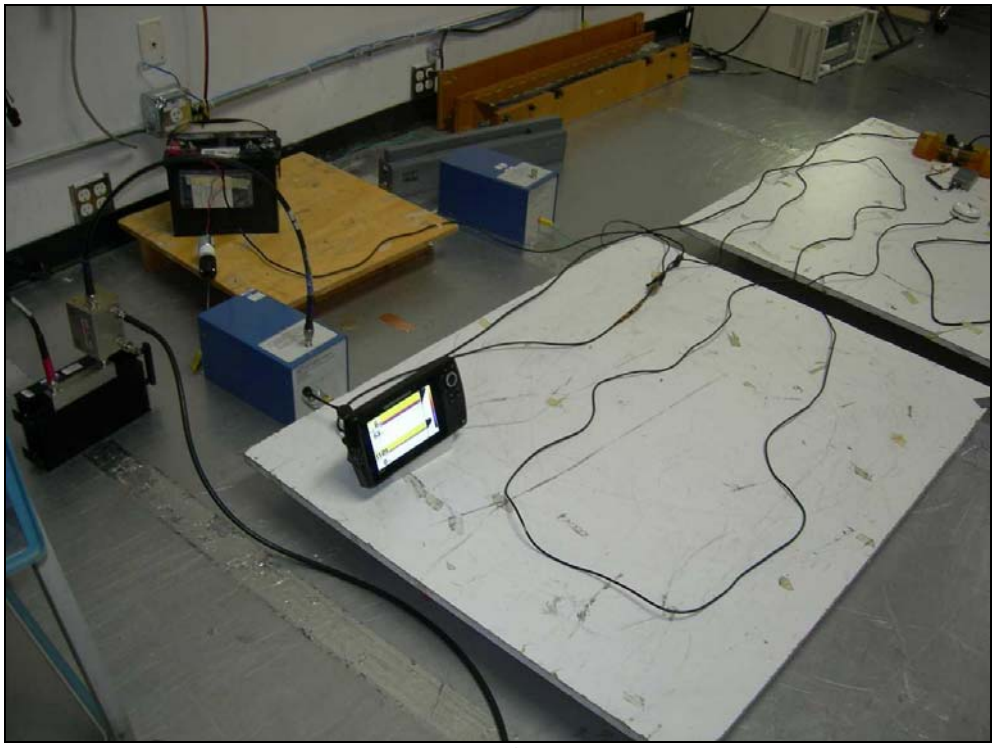


Figure 11.4-1: Test Setup Photograph

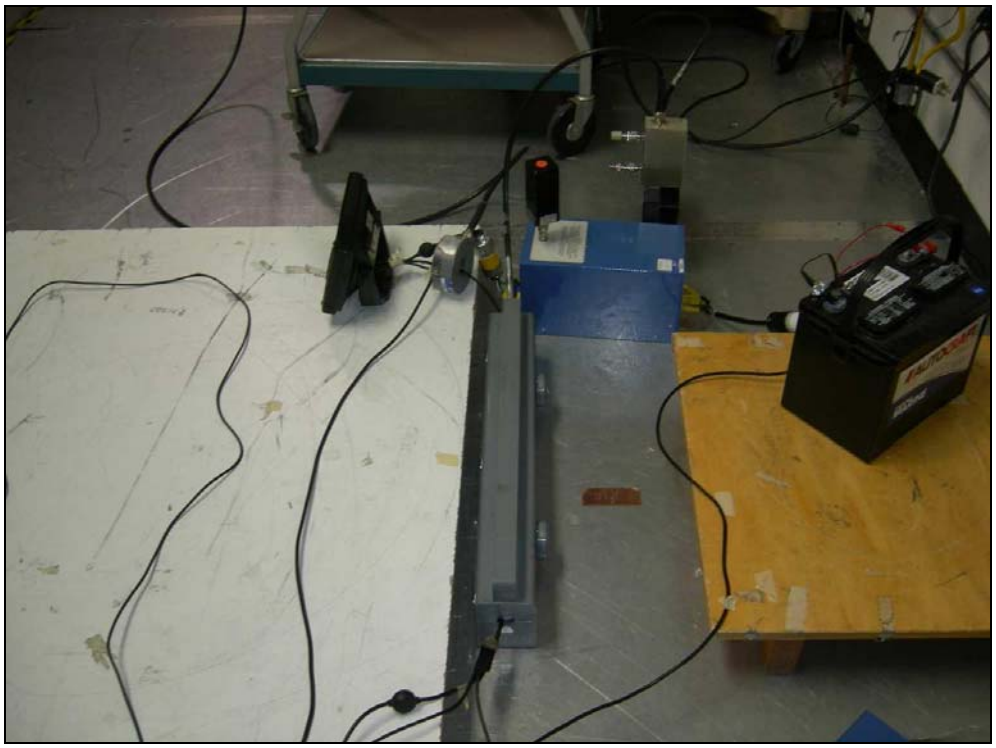


Figure 11.4-2: Test Setup Photograph

11.5 Test Results

Test Parameters:

Test Date:	**January 6, 2015**	**Temperature (ºC)**	**22**
Technician:	**Tommy Payton**	**Humidity (%)**	**30**
Equipment Class:	**N/A**	**Barometric Pressure (mBar)**	**1023**
Tested Modes:	**Monitoring Depth 6.7' & Graphics, Temperature, GPS, Time and Speed at 0mhp.**		
AC Input Power:	**N/A**	☒ **Pre-Test Verification**	
DC Input Power:	**12Vdc**		

Mains Test Data:

Check All That Apply to This Data

Test Level:
☒ 3Vrms
☐ 10Vrms
☐ 15Vrms
☐ Enter Other Level Here

Freq. Band:
☒ .150-80MHz
☐ Enter Other Band Here

Coupling Mode	Result	Observation (Describe any detectable event)
CDN	Pass	

Notes:

Signal Line Test Data:

Check All That Apply to This Data

Test Level:
☒ 3Vrms
☐ 10Vrms
☐ 15Vrms
☐ Enter Other Level Here

Freq. Band:
☒ .150-80MHz
☐ Enter Other Band Here

Signal Line	Result	Observation (Describe any detectable event)
GPS Cable	Pass	Graphics have noise from around 150k to 360kHz. Depth, Temperature, GPS, Time and Speed function properly.
Transducer Cable	Pass	Graphics have noise from around 150k to 550kHz. Depth, Temperature, GPS, Time and Speed function properly.

12.0 Power Frequency Magnetic Fields Immunity

12.1 Test Justification

☐ No justification - The EUT was tested per the appropriate test methods and test plan.
☒ The test method, standard, and/or test plan was deviated from for the following reason:

This test is not applicable, because the EUT is not powered through an AC Mains power supply.

13.0 Voltage Dips and Interruptions

13.1 Test Justification

☐ No justification - The EUT was tested per the appropriate test methods and test plan.
☒ The test method, standard, and/or test plan was deviated from for the following reason:

This test is not applicable, because the EUT is not powered through an AC Mains power supply.

SECTION D: MEASUREMENT UNCERTAINTY

General
Measurement Uncertainty is based on the following publications:

- CISPR 16-4-2: Uncertainties, statistics and limit modeling – Uncertainty in EMC measurements
- The Guide to the Expression of Uncertainty in Measurement(GUM): 1995
- ANSI / NCSL Z540.2-1997 (R2002) U.S. Guide to Expression of Uncertainty in Measurement

Calculations for measurement uncertainty are available upon request.

Emissions:

Test Method	U_{Lab}	U_{CISPR}	Uncertainty Units
Radiated Emissions 30MHz-1000MHz	3.68	5.2	dB
Radiated Emissions 30MHz to 200MHz	3.79	5.2	dB
Radiated Emissions 200 to 1000MHz	3.62	5.2	dB
Radiated Emissions 1-18GHz	3.65	---	dB
Conducted Emissions .150k-30MHz	1.52	3.6	dB
Radiated Disturbances 5MHz to 30MHz	2.81	4.5	dB
Radiated Disturbances 30MHz to 950MHz	2.21	4.5	dB
Harmonic Current Emissions	1.7	---	%
Voltage Fluctuations & Flicker	1.7	---	%
Insertion Loss/Internal Calibrations	.65	---	dB
Radiated Immunity 80-1000MHz	1.21	---	dB
Conducted Immunity .150-80MHz	1.64	---	dB
Frequency Interpolations	.81 (ave)	---	dB

NOTE U_{cispr} resembles a value of measurement uncertainty for a specific test, which was determined by considering uncertainties associated with the quantities listed in CISPR 16-4-2:2003 Section 4.2. Where no value is given for U_{cispr} the procedure below does not apply.

Compliance or non-compliance with a disturbance limit shall be determined in the following manner.

If U_{Lab} is less than or equal to U_{cispr} in Table 5.0-1, then:
- compliance is deemed to occur if no measured disturbance exceeds the disturbance limit;
- non-compliance is deemed to occur if any measured disturbance exceeds the disturbance limit.

If U_{Lab} is greater than U_{cispr}, then:
- compliance is deemed to occur if no measured disturbance, increased by ($U_{Lab} – U_{cispr}$), exceeds the disturbance limit;
- non-compliance is deemed to occur if any measured disturbance, increased by ($U_{Lab} – U_{cispr}$), exceeds the disturbance limit.

The ACS calculated MU is much less than the internationally accepted MU, therefore an adjustment to the measured result as mentioned above is not necessary.

Immunity
The EUT was subjected to the appropriate test levels required by the standard with a confidence level of 95%(k=2).

SECTION E: CONCLUSION
The EUT is determined to meet the requirements as defined in the applicable regulations.

Appendix A: Model Variants

ACS Report: 15-0004.C09.3B
Report Revision: B
Report Issue Date: May 6, 2015

The same display is used on all models, sonar components change values for the various models, sonar only models don't populate the GPS and SD circuitry.

HELIX 7x SONAR ,	**2dSonar Only**
HELIX 7x DI ,	**DI Sonar Only**
HELIX 7x SONAR GPS,	**2dSonar / GPS Combo**
HELIX 7x DI GPS,	**DI Sonar / GPS Combo**
HELIX 7x XD GPS ,	**XD Sonar / GPS Combo**
HELIX 7x SI GPS ,	**SI Sonar / GPS Combo**
HELIX 7x GPS,	**GPS Only**

Excellence in Compliance Testing

5015 B. U. Bowman Dr.
Buford, GA 30518

Wednesday, May 06, 2015

Johnson Outdoors Marine Electronics, Inc.:
678 Humminbird Lane
Eufaula, AL 36027
USA

Tambryn Freund
Tambryn.Freund@johnsonoutdoors.com

Our investigation of the Helix 7 SI GPS has concluded. The results of the investigation are listed below:

Customer requested tests from the following test standard(s) and/or specification(s):

HD SI COMBO	TEST DESCRIPTION	RESULT
EN 60945:2002	Section 11.2 Compass Safe Distance	PASSED

Testing was concluded on January 8, 2015 at our facility in Buford, GA.

This letter accompanies the test data for this product and any other supporting documentation of the testing performed. As always, let me know if you have any questions about the project or specific data. Thank you.

If you have any additional questions, please contact me.

Kind Regards,

Sean Vick
EMC Technician

Excellence in Compliance Testing

5015 B. U. Bowman Dr.
Buford, GA 30518

Test Results

The minimum Compass Safe Distance of this device is 25 CM to the Standard Compass and 20 CM to the Steering Compass.

Test Equipment

Test Equipment

AssetID	Manufacturer	Model #	Equipment Type	Serial #	Last Calibration Date	Calibration Due Date
308	General Radio USA	PLZ150W	Transformer	N/A	NCR	NCR
350	Cammenga	3H	General Lab Equipment	21-26460-02E	4/23/2009	NCR
239	Walker Scientific	ELF-50D	Sensors	K72387-4	2/6/2013	2/6/2015
456	ACS	MG1-1	Antennas	456	NCR	NCR

Test Methodology

Each unit of the EUT shall be tested in the position and altitude relative to the compass or magnetometer which the error produced at the compass would be a maximum, provided the item can be fitted in this way.

The compass safe distance of any unit of the EUT is defined as the distance between the nearest point of the unit and the center of the compass or magnetometer at which it will not produce a deviation in the standard compass of more than 5.4 degree/H where H is the Horizontal component of the magnetic flux density in uT (microtesla) at the place of testing.

For steering compass, the standby steering compass and the emergency compass, the permitted deviation is 18 degree/H, H being defined as above.

Each unit of the EUT shall be tested:

a) In the magnetic condition in which it is received with the EUT un-powered;
b) After normalizing with the EUT un-powered;
c) In the power condition, if the unit is capable of being energized electrically.

Normalizing means a procedure to maximize the homogeneity of the magnetic flux in the EUT by placing it in Helmholtz coils or by other adequate means.

In each of the above tests, the unit shall be rotated to determine the direction in which it produced the maximum deviation.

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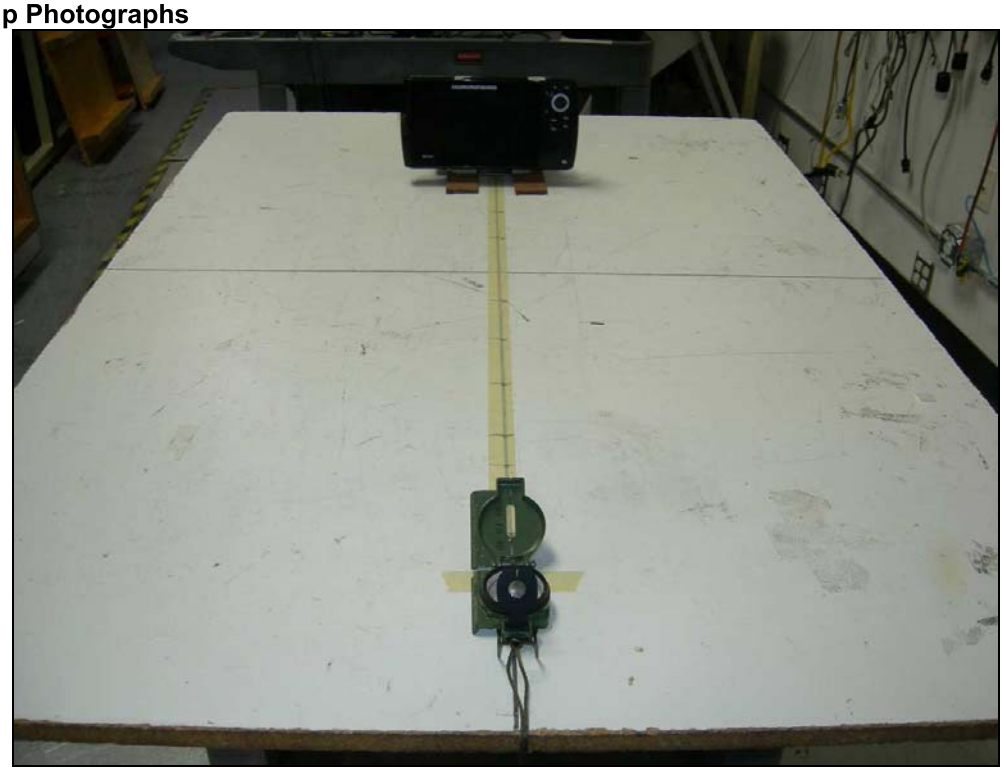
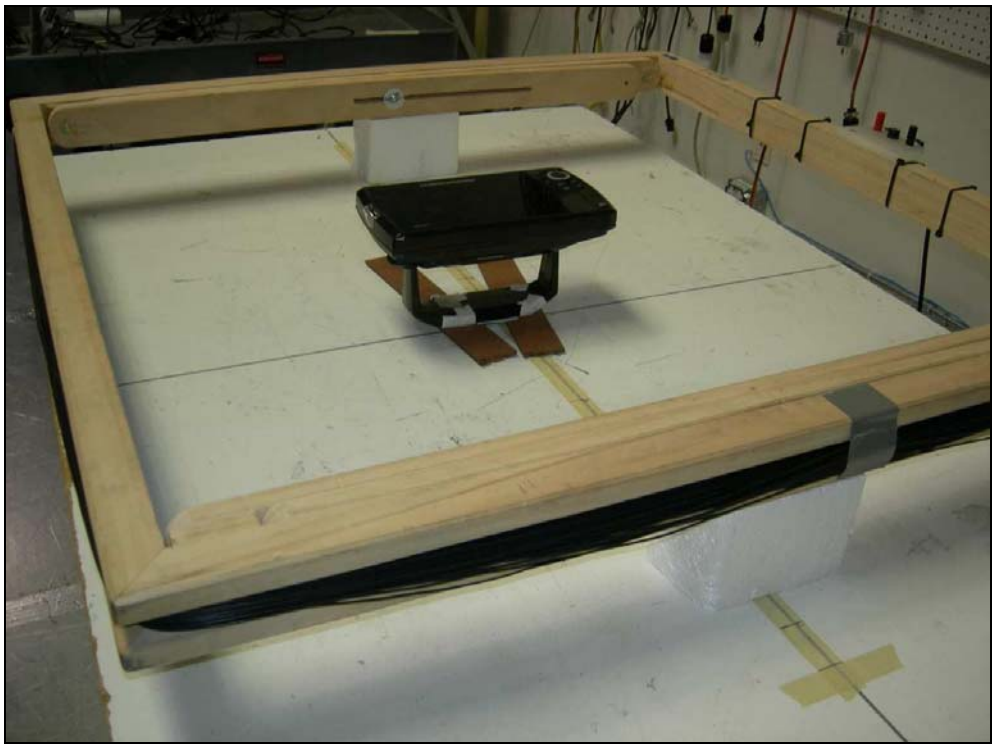
Buford, GA 30518

Test Setup Photographs



Compass Safe Distance Test Setup - Unpowered



Compass Safe Distance Test Setup – Normalized X-Axis

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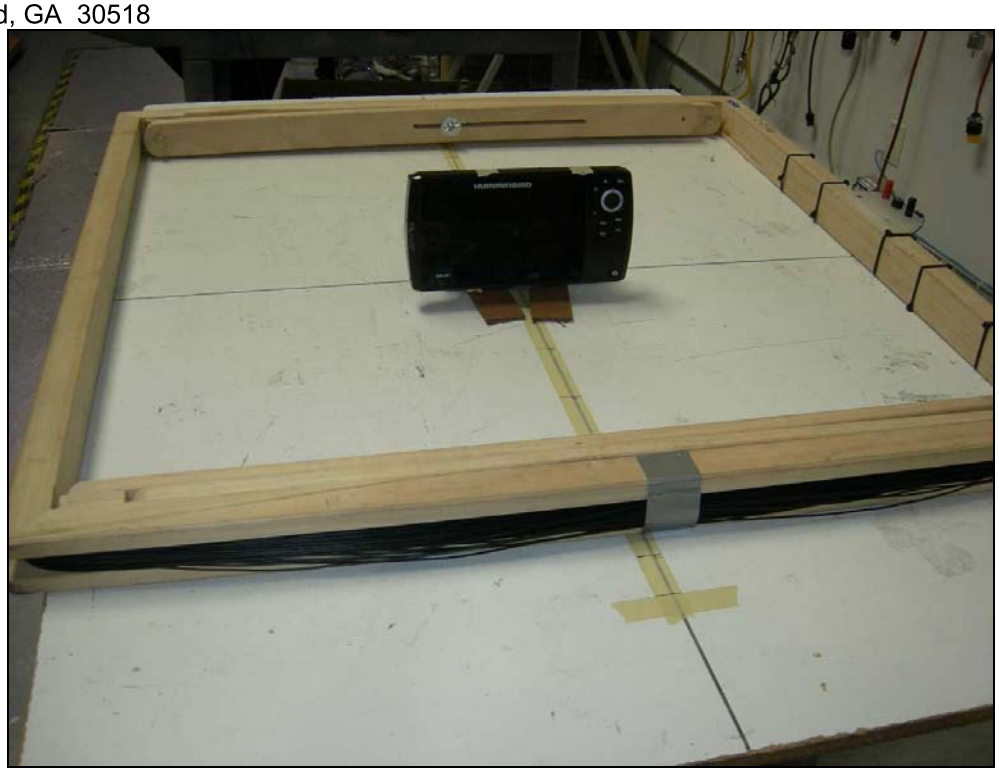
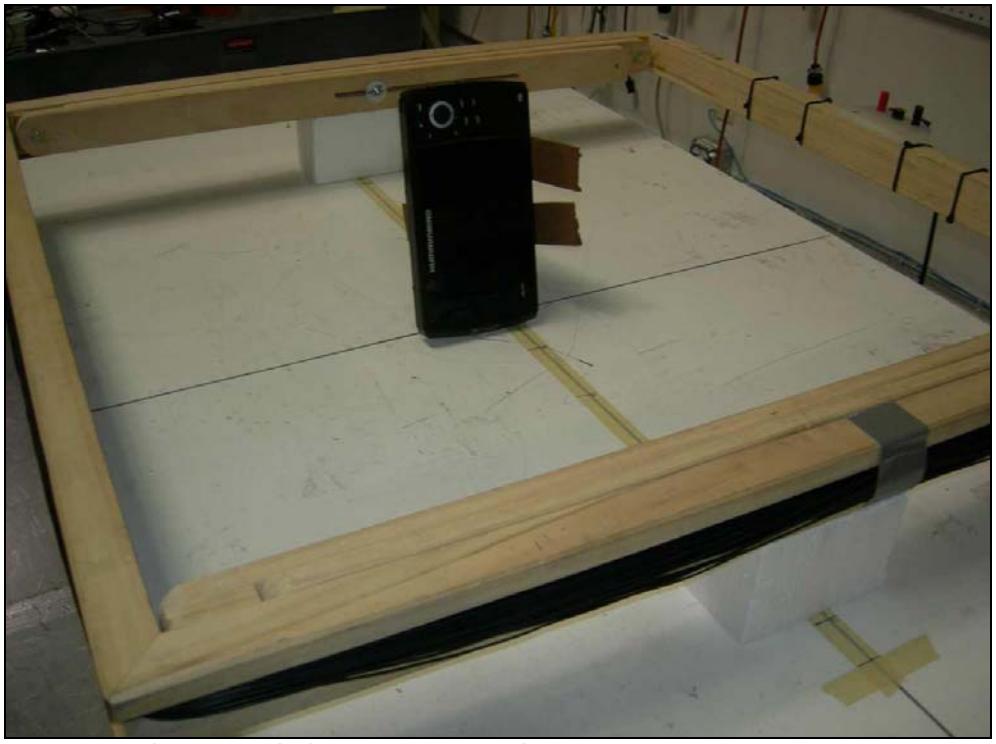
Buford, GA 30518



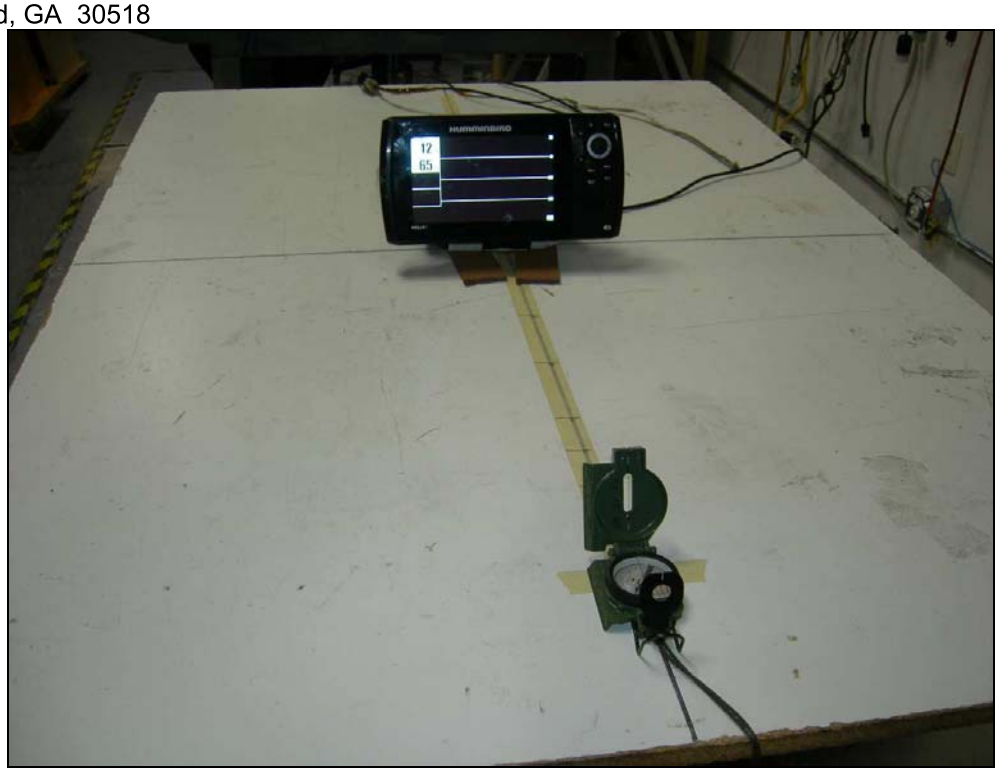
Compass Safe Distance Test Setup – Normalized Y-Axis



Compass Safe Distance Test Setup – Normalized Z-Axis

Excellence in Compliance Testing

5015 B. U. Bowman Dr.
Buford, GA 30518



Compass Safe Distance Test Setup – EUT active

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Buford, GA 30518

Compass Safe Distance Test

Test Parameters:

Test Date:	**January 8, 2015**	**Temperature (ºC)**	**23.9**
Technician:	**Ray Verar**	**Humidity (%)**	**19.2**
Equipment Class:	**N/A**	**Barometric Pressure (mBar)**	**1030.6**
Tested Modes:	**EUT unpowered, unpowered and normalized, EUT powered and active**		
AC Input Power:	**N/A**		
DC Input Power:	**12Vdc**		

Orientation	Angle of Deflection (0.25/0.8)	Standard Compass Distance	Steering Compass Distance	Mode
0	(0.25/0.8)	15	10	As received, EUT unpowered
90	(0.25/0.8)	15	10	As received, EUT unpowered
180	(0.25/0.8)	15	10	As received, EUT unpowered
270	(0.25/0.8)	10	5	As received, EUT unpowered
0	(0.25/0.8)	15	10	Unpowered, normalized on X axis
90	(0.25/0.8)	10	5	Unpowered, normalized on X axis
180	(0.25/0.8)	15	10	Unpowered, normalized on X axis
270	(0.25/0.8)	15	10	Unpowered, normalized on X axis
0	(0.25/0.8)	15	10	Unpowered, normalized on Y axis
90	(0.25/0.8)	15	10	Unpowered, normalized on Y axis
180	(0.25/0.8)	20	15	Unpowered, normalized on Y axis
270	(0.25/0.8)	15	10	Unpowered, normalized on Y axis
0	(0.25/0.8)	15	10	Unpowered, normalized on Z axis
90	(0.25/0.8)	10	5	Unpowered, normalized on Z axis
180	(0.25/0.8)	20	15	Unpowered, normalized on Z axis
270	(0.25/0.8)	10	5	Unpowered, normalized on Z axis
0	(0.25/0.8)	25	20	EUT powered
90	(0.25/0.8)	20	15	EUT powered
180	(0.25/0.8)	20	15	EUT powered
270	(0.25/0.8)	15	10	EUT powered

Notes:
Normalizing was performed with 138.6A/m @ DC for 1 minute in each of three axis.

Excellence in Compliance Testing

Test Report to EN 300 440-2 V1.4.1

Electromagnetic compatibility and Radio spectrum Matters (ERM);
Short range devices;
Radio equipment to be used in the 1 GHz to 40 GHz frequency range;
Part 2: Harmonized EN covering the essential requirements of article 3.2 of the R&TTE Directive

ACS Report Number: 15-0004.W09.1A

Manufacturer: Johnson Outdoors Marine Electronics, Inc.

Model(s): HELIX 7 SI GPS

Test Begin Date: January 8, 2015
Test End Date: January 8, 2015

Report Issue Date: March 12, 2015

FOR THE SCOPE OF ACCREDITATION UNDER LAB Code 200612-0

This report must not be used by the client to claim product certification, approval, or endorsement by NVLAP, NIST, or any agency of the Federal Government.

Reviewed by: _____
Kirby Munroe
Director Wireless Certifications
ACS, Inc.

This report contains 23 pages

Table of Contents

1.0 GENERAL

1.1 Purpose

The purpose of this report is to demonstrate compliance with the essential requirements of EN 300 440-2 V1.4.1 using the test methods and limits as referenced and defined in EN 300 440-1 V1.6.1.

1.2 Product Description

Product Name: HELIX 7 SI GPS

Product Description: The HUMMINBIRD HELIX 7 SI GPS is a fishfinder/GPS product with Side Imaging sonar capability to be used in the marine environment. It is comprised of a keypad, LCD display, micro SD card slot, Internal GPS, transducer and power cable.

The summary of the model variations are as follows:

HELIX 7x SONAR ,	2dSonar Only
HELIX 7x DI ,	DI Sonar Only
HELIX 7x XD ,	XD Sonar
HELIX 7x SONAR GPS,	2dSonar / GPS Combo
HELIX 7x DI GPS,	DI Sonar / GPS Combo
HELIX 7x XD GPS ,	XD Sonar / GPS Combo
HELIX 7x SI GPS ,	SI Sonar / GPS Combo (Tested Variant)
HELIX 7x GPS,	GPS Only

Internal GPS Receiver
72-channel u-blox M8 engine operating at GPS L1 C/A (1575.42 MHz)

Serial number: 14121724-0001

Technical Information:

Detail	Description
Receiver Frequency / Alignment Range	1575.42 MHz
Operating Voltage	10-20 VDC
Internal Antenna Type / Gain:	5.2mmX3.7mmX0.7mm linear chip antenna / 1.94dBi
Receiver Category	3
Temperature Category	I (General): -20 °C to +55 °C
Type of equipment:	Mobile
Hardware version:	GPS Receiver: 00080000
Software release:	GPS Engine FW Rev.: 2.01

Manufacturer Information:
Johnson Outdoors Marine Electronics, Inc.
678 Humminbird Lane
Eufaula, AL 36027- USA

Test sample received on: January 5, 2015

Test Sample Condition: The test samples were provided in good working order with no visible defects.

1.3 Test Methodology and Considerations

No deviation from the test methods specified in EN 300 440-1 was applied.

The EUT was configured such that all accessory and support equipment was located outside the test environment to the extent possible. Those components related to the GPS receivers were included in the test environment to facilitate measurement of emissions only related to the GPS receiver.

The GPS receiver was operating throughout the duration of the tests. A GPS repeater was utilized to provide an external GPS signal to the receivers. See section 4.0 for additional details.

1.4 Modifications of EUT

No modifications of the EUT were required.

1.5 References

- ETSI EN 300 440-1 (V1.6.1): " Electromagnetic compatibility and Radio spectrum Matters (ERM); Short range devices; Radio equipment to be used in the 1 GHz to 40 GHz frequency range; Part 1: Technical characteristics and test methods".
- ETSI EN 300 440-2 (V1.4.1): “Electromagnetic compatibility and Radio spectrum Matters (ERM); Short range devices; Radio equipment to be used in the 1 GHz to 40 GHz frequency range; Part 2: Harmonized EN covering the essential requirements of article 3.2 of the R&TTE Directive”

2.0 TEST FACILITIES

2.1 Location

The radiated and conducted emissions test sites are located at the following address:

Advanced Compliance Solutions
5015 B.U. Bowman Drive
Buford, GA 30518
Phone: (770) 831-8048
Fax: (770) 831-8598

2.2 Laboratory Accreditations/Recognitions/Certifications

ACS is accredited to ISO/IEC 17025 by the National Institute of Standards and Technology under their National Voluntary Laboratory Accreditation Program (NVLAP), Lab Code 200612-0. Unless otherwise specified, all tests methods described within this report are covered under the ISO/IEC 17025 scope of accreditation.

The Semi-Anechoic Chamber Test Site, Open Area Test Site (OATS) and Conducted Emissions Site have been fully described, submitted to, and accepted by the FCC, Industry Canada and the Japanese Voluntary Control Council for Interference by information technology equipment.

FCC Registration Number: 511277
Industry Canada Lab Code: IC 4175A
VCCI Member Number: 1831

- VCCI OATS Registration Number R-1526
- VCCI Conducted Emissions Site Registration Number: C-1608

2.3 Radiated Emissions Test Site Description

2.3.1 Semi-Anechoic Chamber Test Site

The Semi-Anechoic Chamber Test Site consists of a 20' x 30' x 18' shielded enclosure. The chamber is lined with Toyo Ferrite Grid Absorber, model number FFG-1000. The ferrite tile grid is 101 x 101 x 19mm thick and weighs approximately 550 grams. These tiles are mounted on steel panels and installed directly on the inner walls of the chamber.

The turntable is 150cm in diameter and is located 160cm from the back wall of the chamber. The chamber is grounded via 1 - 8' copper ground rod, installed at the center of the back wall, it is bound to the ground plane using 3/4" stainless steel braided cable.

The turntable is all steel, flush mounted table installed in an all steel frame. The table is remotely operated from inside the control room located 25' from the range. The turntable is electrically bonded to the surrounding ground plane via steel fingers installed on the edge of the turn table. The steel fingers make constant contact with the ground plane during operation.

Behind the turntable is a 3' x 6' x 4' deep shielded pit used for support equipment if necessary. The pit is equipped with 1 - 4" PVC chases from the turntable to the pit that allow for cabling to the EUT if necessary. The underside of the turntable can be accessed from the pit so cables can be supplied to the EUT from the pit.

A diagram of the Semi-Anechoic Chamber Test Site is shown in Figure 2.3-1 below:

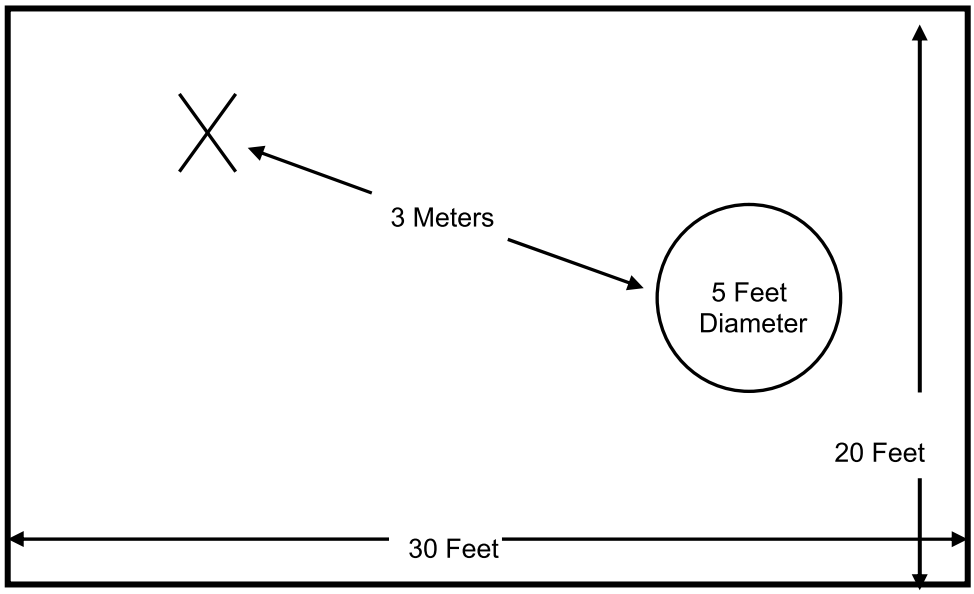

Figure 2.3-1: Semi-Anechoic Chamber Test Site

2.3.2 Open Area Tests Site (OATS)

The open area test site consists of a 40' x 66' concrete pad covered with a perforated electro-plated galvanized sheet metal. The perforations in the sheet metal are 1/8" holes that are staggered every 3/16". The individual sheets are placed to overlap each other by 1/4" and are riveted together to provide a continuous seam. Rivets are spaced every 3" in a 3 x 20 meter perimeter around the antenna mast and EUT area. Rivets in the remaining area are spaced as necessary to properly secure the ground plane and maintain the electrical continuity.

The entire ground plane extends 12' beyond the turntable edge and 16' beyond the antenna mast when set to a 10 meter measurement distance. The ground plane is grounded via 4 - 8' copper ground rods, each installed at a corner of the ground plane and bound to the ground plane using 3/4" stainless steel braided cable.

The turntable is an all aluminum 10' flush mounted table installed in an all aluminum frame. The table is remotely operated from inside the control room located 40' from the range. The turntable is electrically bonded to the surrounding ground plane via steel fingers installed on the edge of the turn table. The steel fingers make constant contact with the ground plane during operation.

Adjacent to the turntable is a 7' x 7' square and 4' deep concrete pit used for support equipment if necessary. The pit is equipped with 5 - 4" PVC chases from the pit to the control room that allow for cabling to the EUT if necessary. The underside of the turntable can be accessed from the pit so cables can be supplied to the EUT from the pit. The pit is covered with 2 sheets of 1/4" diamond style re-enforced steel sheets. The sheets are painted to match the perforated steel ground plane; however the underside edges have been masked off to maintain the electrical continuity of the ground plane. All reflecting objects are located outside of the ellipse defined in ANSI C63.4.

A diagram of the Open Area Test Site is shown in Figure 2.3-2 below:

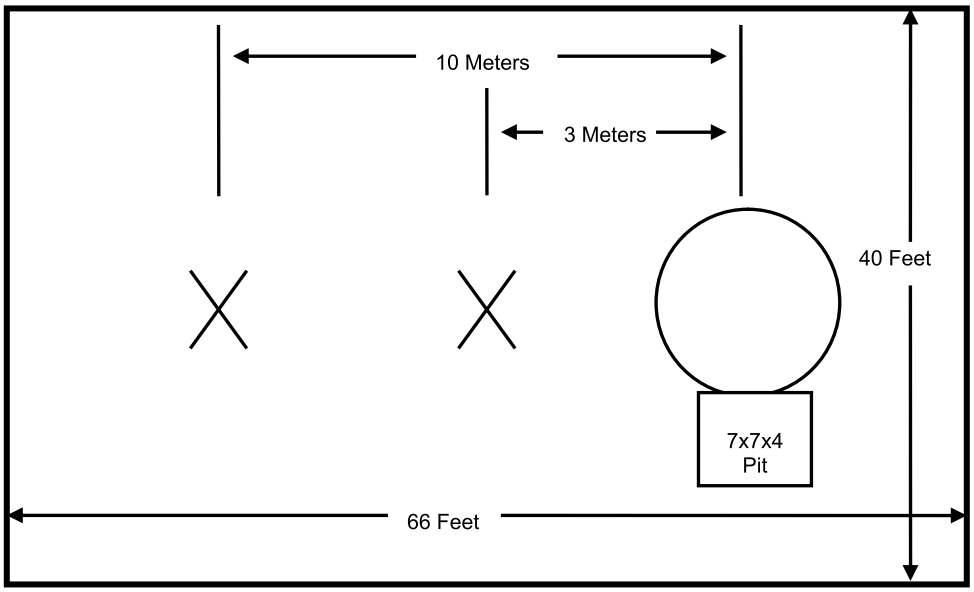

Figure 2.3-2: Open Area Test Site

3.0 EQUIPMENT UNDER TEST SYSTEM BLOCK DIAGRAM

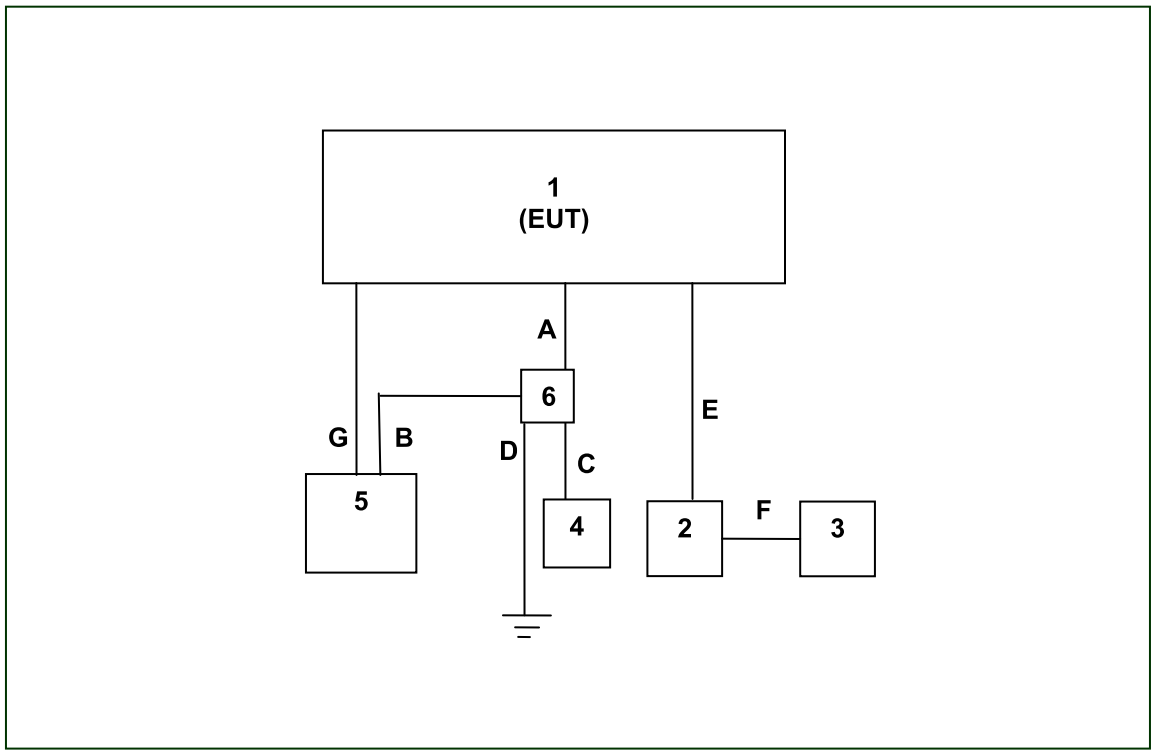

Figure 3-1: EUT System Block Diagram

Table 3-1: EUT and Support Equipment Description

Item #	Type Device	Manufacturer	Model/Part #	Serial #
1	EUT	Johnson Outdoors	Helix 7 SI GPS	14121724-0001
2	Transducer	Johnson Outdoors	N/A	N/A
3	Depth Simulator	Johnson Outdoors	N/A	N/A
4	GPS Antenna	Humminbird	AS GR50 GPS module	10102742-0165
5	12Vdc Battery	AUTOCRAFT	M24-1	N/A
6	Cable Split	N/A	N/A	N/A

NOTE: The GPS antenna (Item 4) was used to simulate a serial load and was not active. The GPS included in this evaluation is internal to the EUT.

Table 3-2: Cable Description

Cable #	Cable Type	Length	Shield	Termination
A	Signal cable	1m	No	1 - 6
B	Power cable	1.8m	No	5 - 6
C	Signal cable	6m	No	4 - 6
D	Ground braid	1m	No	6 - ground
E	Transducer cable	6m	No	1 - 2
F	Transducer cable	1m	No	2 - 3
G	Power cable	1m	No	1 - 5

4.0 TEST SETUP BLOCK DIAGRAM(S)

RECEIVER SPURIOUS EMISSIONS

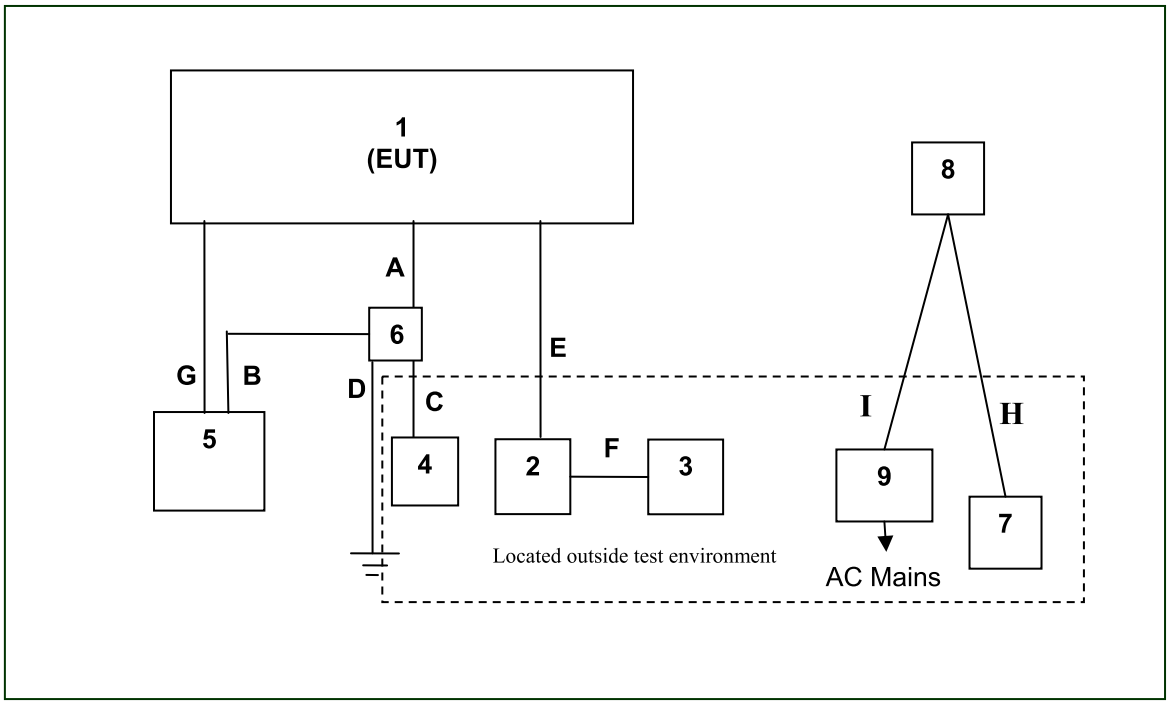

Figure 4-1: EUT System Block Diagram

Table 4-1: EUT and Support Equipment Description

Item #	Type Device	Manufacturer	Model/Part #	Serial #
1	EUT	Johnson Outdoors	Helix 7 SI GPS	14121724-0001
2	Transducer	Johnson Outdoors	N/A	N/A
3	Depth Simulator	Johnson Outdoors	N/A	N/A
4	GPS Antenna	Humminbird	AS GR50 GPS module	10102742-0165
5	12Vdc Battery	AUTOCRAFT	M24-1	N/A
6	Cable Split	N/A	N/A	N/A
7	GPS Antenna	NavsGo	G-503	N/A
8	GPS Antenna	NavsGo	N/A	N/A
9	Wall Wart Power Supply	TL Courier Charger	TL-803<IC>	N/A

Table 4-2: Cable Description

Cable #	Cable Type	Length	Shield	Termination
A	Signal cable	1m	No	1 - 6
B	Power cable	1.8m	No	5 - 6
C	Signal cable	6m	No	4 - 6
D	Ground braid	1m	No	6 - ground
E	Transducer cable	6m	No	1 - 2
F	Transducer cable	1m	No	2 - 3
G	Power cable	1m	No	1 - 5
H	RF Cable	550 cm	Yes	7 - 8
I	USB Cable	115 cm	Yes	8 - 9

5.0 CONCLUSIONS, OBSERVATIONS AND COMMENTS

The test report will be filed at Advanced Compliance Solutions for a period of 10 years following the issue of this report. It may only be reproduced or published in full. Reproduction or publication of extracts from the report requires the prior written approval from Advanced Compliance Solutions.

The results of the tests as stated in this report are exclusively applicable to the EUT as identified in this report. Advanced Compliance Solutions cannot be held liable for properties of the EUT that have not been observed during these tests.

Advanced Compliance Solutions assumes the sample to comply with the requirements of EN 300 440-1,-2 for the respective test sector, if the test results turn out positive.

Comments: The provider was responsible for ensuring the test samples provided were representative of final production units.

6.0 MEASUREMENT UNCERTAINTY

Measurement uncertainties associated with each test have been estimated and expressed in table 6-1 below:

Table 6-1: Measurement Uncertainties

EN300 440 ACS Measurement Uncertainties: Maximum Values		
Parameter	**U_{Std}**	**U_{Lab}**
Radio Frequency	±1 x 10^{-7}	±2.832 x 10^{-8}
RF Power, Conducted	±2,5dB	± 0.680 dB
Radiated Emission of Transmitter, valid to 26,5 GHz	±6 dB	± 5.810 dB
Radiated Emission of Transmitter, valid between 26,5 GHz and 66 GHz[1]	±8 dB	± 4.318 dB
Radiated Emission of Receiver, valid to 26,5 GHz	±6 dB	± 5.810 dB
Radiated Emission of Receiver, valid between 26,5 GHz and 66 GHz[1]	±8 dB	± 4.318 dB
Temperature	±1 °C	± 0.860 °C
Humidity	±5 %	± 0.740 %
Voltage (DC)	±1 %	± 0.566 %
Voltage (AC, <10 kHz)	±2 %	± 1.132 %
[1] ACS does not have measurement equipment capable of measuring radiated emissions above 40GHz. The uncertainty values used for these parameters are only valid to 40GHz.		
Note: For radiated emissions above 26,5 GHz it may not be possible to achieve measurement uncertainties complying with the levels specified in this table. In these cases alone it is acceptable to employ the alternative interpretation procedure specified in clause 10.1.		

The above expanded laboratory measurement uncertainty figures correspond to an expansion factor (coverage factor) k = 1.96 which provide confidence levels of 95%.

7.0 TEST RESULTS SUMMARY

7.1 Results summary

The tables 7.1.1-1 and 7.1.1-2 summarize the results for the tested EUT corresponding with the essential requirements defined in EN 300 440-2.

7.1.1 Transmitter

Table 7.1.1-1: Transmitter results summary

Harmonized Standard EN 300 440-2 The following requirements and test specifications are relevant to the presumption of conformity under the article 3.2 of the R&TTE Directive							
Requirement			**Test Result**			**Test Specification**	
No	**Description**	**Reference: Clause No**	**P (Pass)**	**F (Fail)**	**N.t. (Not tested)**	**Reference: Clause No**	**Test Report Page No.**
1	Equivalent isotropically radiated power	4.2.1.1	☐	☐	☒	5.3.1	N.t.
2	Permitted range of operating frequencies	4.2.1.2	☐	☐	☒	5.3.2	N.t.
3	Unwanted emissions in the spurious domain	4.2.1.3	☐	☐	☒	5.3.3	N.t.
4	Duty cycle	4.2.1.4	☐	☐	☒	NA	N.t.

7.1.2 Receiver

Table 7.1.2-1: Receiver results summary

Harmonized Standard EN 300 440-2 The following requirements and test specifications are relevant to the presumption of conformity under the article 3.2 of the R&TTE Directive							
Requirement			**Test Result**			**Test Specification**	
No	**Description**	**Reference: Clause No**	**P (Pass)**	**F (Fail)**	**N.t. (Not tested)**	**Reference: Clause No**	**Test Report Page No.**
5	Adjacent channel selectivity	4.2.2.1	☐	☐	☒	5.4.1	N.t.
6	Blocking or desensitization	4.2.2.2	☐	☐	☒	5.4.2	N.t.
7	Spurious radiations	4.2.2.3	☒	☐	☐	5.4.3	15

7.1.3 2.45 GHz RFID systems

Table 7.1.3-1: 2,45 GHz RFID systems results summary

Harmonized Standard EN 300 440-2 The following requirements and test specifications are relevant to the presumption of conformity under the article 3.2 of the R&TTE Directive							
Requirement			**Test Result**			**Test Specification**	
No	**Description**	**Reference: Clause No**	**P (Pass)**	**F (Fail)**	**N.t. (Not tested)**	**Reference: Clause No**	**Test Report Page No.**
8	2,45 GHz RFID systems	4.2.3	☐	☐	☒	5.5	N.t.

7.1.4 GBSAR systems

Table 7.1.4-1: GBSAR systems results summary

Harmonized Standard EN 300 440-2 The following requirements and test specifications are relevant to the presumption of conformity under the article 3.2 of the R&TTE Directive							
Requirement			**Test Result**			**Test Specification**	
No	**Description**	**Reference: Clause No**	**P (Pass)**	**F (Fail)**	**N.t. (Not tested)**	**Reference: Clause No**	**Test Report Page No.**
9	Effective radiated power	4.2.4.1	☐	☐	☒	5.6.1	N.t.
10	Permitted range of operating frequencies	4.2.4.2	☐	☐	☒	5.6.2	N.t.
11	DAA threshold	4.2.4.3	☐	☐	☒	5.6.3	N.t.
12	Minimum listen time	4.2.4.3.1.1	☐	☐	☒	5.6.4.1	N.t.
13	Minimum listen time after detection	4.2.4.3.1.2	☐	☐	☒	5.6.4.2	N.t.
14	Maximum transmit on-time	4.2.4.3.1.3	☐	☐	☒	5.6.4.3	N.t.
15	Minimum transmit off-time	4.2.4.3.1.4	☐	☐	☒	5.6.4.4	N.t.
16	Antenna pattern	4.2.4.4	☐	☐	☒	5.6.5	N.t.
17	Unwanted emissions in the spurious domain	4.2.4.5	☐	☐	☒	5.6.6	N.t.

8.0 TEST RESULTS

8.1 Transmitter Parameters

8.1.1 Equivalent Isotropically Radiated Power (e.i.r.p)

Verdict			~~Pass~~	~~Fail~~	N.t.
Further test results are attached	~~Yes~~	No	Page no.: NA		

Test equipment used with equipment no.: NA

N.t. (NOT TESTED): This evaluation addresses the GPS/GNSS receiver only.

8.1.2 Permitted Range of Operating Frequencies

Verdict			~~Pass~~	~~Fail~~	N.t.
Further test results are attached	~~Yes~~	No	Page no.: NA		

Test equipment used with equipment no.: NA

N.t. (NOT TESTED): This evaluation addresses the GPS/GNSS receiver only.

8.1.3 Unwanted Emissions in the Spurious Domain

Verdict			~~Pass~~	~~Fail~~	N.t.
Further test results are attached	~~Yes~~	No	Page no.: NA		

Test equipment used with equipment no.: NA

N.t. (NOT TESTED): This evaluation addresses the GPS/GNSS receiver only.

8.1.4 Duty Cycle

Verdict			~~Pass~~	~~Fail~~	N.t.
Further test results are attached	~~Yes~~	No	Page no.: NA		

Test equipment used with equipment no.: NA

N.t. (NOT TESTED): The UUT does not include RFID in the 2446 MHz to 2454 MHz band.

8.1.5 Additional Requirements for FHSS Equipment

Verdict			~~Pass~~	~~Fail~~	N.t.
Further test results are attached	~~Yes~~	No	Page no.: NA		

Test equipment used with equipment no.: NA

N.t. (NOT TESTED): This evaluation addresses the GPS/GNSS receiver only.

8.2 Receiver Parameters

8.2.1 Adjacent Channel Selectivity

Verdict			~~Pass~~	~~Fail~~	N.t.
Further test results are attached	~~Yes~~	No	Page no.: NA		

Test equipment used with equipment no.: NA

N.t. (NOT TESTED): The UUT is a category 3 receiver.

8.2.2 Blocking or Desensitization

Verdict			~~Pass~~	~~Fail~~	N.t.
Further test results are attached	~~Yes~~	No	Page no.: NA		

Test equipment used with equipment no.: NA

N.t. (NOT TESTED): The UUT is a category 3 receiver.

8.2.3 Spurious Emissions

The power of any spurious emission, radiated or conducted, shall not exceed the values given below.

The limits are applicable to all receiver categories:
- 2 nW below 1 000 MHz;
- 20 nW above 1 000 MHz.

Receiver radiated spurious emissions where performed on the host cabinet with the antenna attached. Therefore conducted spurious emissions are not required.

Table 8.2.3-1: Receiver spurious emissions

Measurement Method (see EN 300 440-1, clause 8.3):				
Frequency: 1575.42 MHz Rel. humidity: 21% Ambient temp.: 22.5°C Air pressure: 1033mb		Receiver spurious radiation		
Frequency Range	Test frequency (MHz)	Maximum emission observed (dBm)	Limit (dBm)	Margin (dBm)
30 MHz to 1 GHz	97.06	-61.45	-57	4.45
1 GHz to 18 GHz	-----	Noise Floor	-47	----

Frequency (MHz)	Spectrum Analyzer Level (dBm)	Generator Level (dBm)	Antenna Polarity (H/V)	Correction Factors (dB)	Corrected Level (dBm)	Limit (dBm)	Margin (dB)
33.11	-72.96	-67.30	V	-15.43	-82.73	-57.00	25.73
34.53	-89.8	-97.1	V	-14.77	-111.87	-57.00	54.87
97.06	-58.84	-58.5	V	-2.95	-61.45	-57.00	4.45
103.29	-85.94	-89.5	V	-2.79	-92.29	-57.00	35.29
431.11	-66.51	-68.1	H	3.47	-64.63	-57.00	7.63
663.11	-73.75	-71.6	V	3.00	-68.60	-57.00	11.60

Note: The measuring receiver was tuned over the frequency range 30 MHz to 18 GHz (> 10x the receive frequency).

The bandwidth of the measuring receiver was adjusted until the sensitivity of the measuring receiver was at least 6 dB below the spurious emission limit. The RBW was set to 120 kHz for measurements < 1000 MHz and 1 MHz for measurements ≥ 1000 MHz.

Some of the emissions detected are results of emanations from the digital device or peripheral circuitry and components. Those emissions determined to be directly related to the digital device or peripheral circuitry and components are not included.

Verdict			**Pass**	~~**Fail**~~	~~**N.t.**~~
Further test results are attached	~~**Yes**~~	**No**	**Page no.: NA**		

Test equipment used with equipment no.: 1, 2, 30, 40, 73, 167, 277, 292, 329, 338, 412, 422, 544, 563, 609, 616

8.3 2,45 GHz RFID systems parameters

Verdict			~~Pass~~	~~Fail~~	N.t.
Further test results are attached	~~Yes~~	No	Page no.: NA		

Test equipment used with equipment no.: NA

N.t. (NOT TESTED): This evaluation addresses the GPS/GNSS receiver only.

8.4 GBSAR systems parameters

8.4.1 Effective radiated power

Verdict			~~Pass~~	~~Fail~~	N.t.
Further test results are attached	~~Yes~~	No	Page no.: NA		

Test equipment used with equipment no.: NA

N.t. (NOT TESTED): This evaluation addresses the GPS/GNSS receiver only.

8.4.2 Permitted range of operating frequencies

Verdict			~~Pass~~	~~Fail~~	N.t.
Further test results are attached	~~Yes~~	No	Page no.: NA		

Test equipment used with equipment no.: NA

N.t. (NOT TESTED): This evaluation addresses the GPS/GNSS receiver only.

8.4.3 DAA threshold

Verdict			~~Pass~~	~~Fail~~	N.t.
Further test results are attached	~~Yes~~	No	Page no.: NA		

Test equipment used with equipment no.: NA

N.t. (NOT TESTED): This evaluation addresses the GPS/GNSS receiver only.

8.4.4 Minimum listen time

Verdict			~~Pass~~	~~Fail~~	N.t.
Further test results are attached	~~Yes~~	No	Page no.: NA		

Test equipment used with equipment no.: NA

N.t. (NOT TESTED): This evaluation addresses the GPS/GNSS receiver only.

8.4.5 Minimum listen time after detection

Verdict			~~Pass~~	~~Fail~~	N.t.
Further test results are attached	~~Yes~~	No	Page no.: NA		

Test equipment used with equipment no.: NA

N.t. (NOT TESTED): This evaluation addresses the GPS/GNSS receiver only.

8.4.6 Maximum transmit on-time

Verdict			~~Pass~~	~~Fail~~	N.t.
Further test results are attached	~~Yes~~	No	Page no.: NA		

Test equipment used with equipment no.: NA

N.t. (NOT TESTED): This evaluation addresses the GPS/GNSS receiver only.

8.4.7 Minimum transmit off-time

Verdict			~~Pass~~	~~Fail~~	N.t.
Further test results are attached	~~Yes~~	No	Page no.: NA		

Test equipment used with equipment no.: NA

N.t. (NOT TESTED): This evaluation addresses the GPS/GNSS receiver only.

8.4.8 Antenna pattern

Verdict			~~Pass~~	~~Fail~~	N.t.
Further test results are attached	~~Yes~~	No	Page no.: NA		

Test equipment used with equipment no.: NA

N.t. (NOT TESTED): This evaluation addresses the GPS/GNSS receiver only.

8.4.9 Unwanted emissions in the spurious domain

Verdict			~~Pass~~	~~Fail~~	N.t.
Further test results are attached	~~Yes~~	No	Page no.: NA		

Test equipment used with equipment no.: NA

N.t. (NOT TESTED): This evaluation addresses the GPS/GNSS receiver only.

9.0 TEST SET-UPS

Figure 9-1: Test Setup (Radiated Emissions)

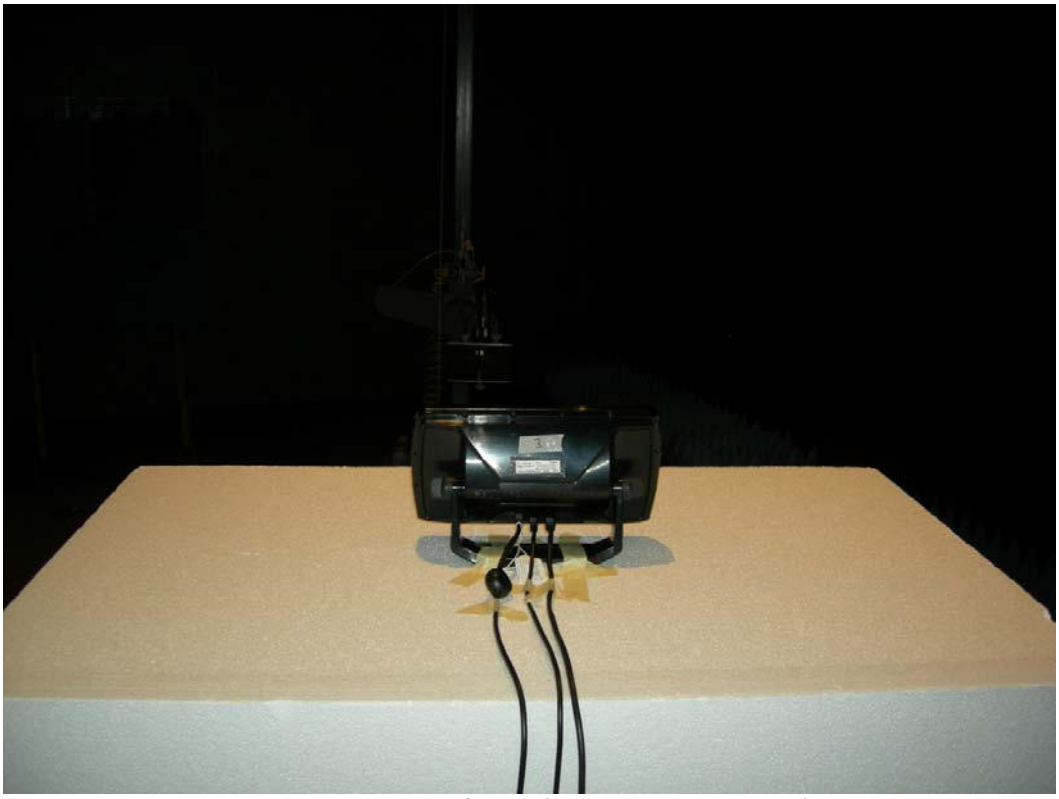

Figure 9-2: Test Setup (Radiated Emissions)

10.0 SCREEN PLOTS / SCREEN CAPTURES

No screen plots or screen captures collected.

11.0 PHOTOGRAPHS OF THE EQUIPMENT (UUT)

Figure 11-1: External View

Figure 11-2: External View

Figure 11-3: External View

Figure 11-4: External View

Figure 11-5: External View

12.0 TEST EQUIPMENT

The calibration interval of test equipment is annually or the manufacturer's recommendations. Where the calibration interval deviates from the annual cycle based on the instrument manufacturer's recommendations, it shall be stated below.

Table 12-1: Test Equipment

AssetID	Manufacturer	Model #	Equipment Type	Serial #	Last Calibration Date	Calibration Due Date
1	Rohde & Schwarz	ESMI - Display	Spectrum Analyzers	833771/007	7/11/2014	7/11/2015
2	Rohde & Schwarz	ESMI-Receiver	Spectrum Analyzers	839587/003	7/11/2014	7/11/2015
30	Spectrum Technologies	DRH-0118	Antennas	970102	4/23/2013	4/23/2015
40	EMCO	3104	Antennas	3211	2/14/2013	2/14/2015
73	Agilent	8447D	Amplifiers	2727A05624	7/15/2014	7/15/2015
167	ACS	Chamber EMI Cable Set	Cable Set	167	10/28/2014	10/28/2015
277	Emco	93146	Antennas	9904-5199	9/2/2014	9/2/2016
292	Florida RF Cables	SMR-290AW-480.0-SMR	Cables	None	3/17/2014	3/17/2015
329	A.H.Systems	SAS-571	Antennas	721	7/15/2013	7/15/2015
338	Hewlett Packard	8449B	Amplifiers	3008A01111	7/30/2013	7/30/2015
412	Electro Metrics	LPA-25	Antennas	1241	7/24/2014	7/24/2016
422	Florida RF	SMS-200AW-72.0-SMR	Cables	805	11/5/2014	11/5/2015
544	ETS Lindgren	3110B	Antennas	3361	11/22/2013	11/22/2015
563	United Microwave Products, Inc.	AA-190-20.00.0	Cables	563	7/22/2014	7/22/2015
609	Rohde & Schwarz	SMB100A	Signal Generators	175334	6/13/2014	6/13/2015
616	Florida RF Cables	SMRE-200W-12.0-SMRE	Cables	N/A	9/10/2014	9/10/2015

END REPORT

Excellence in Compliance Testing

Test Report

Prepared For: Johnson Outdoors

Model Covered:
Helix 7 SI GPS

In Accordance with:
EN 60950-1:2006
Clauses:
4.5.4 – Touch Temperatures
5.1 – Touch Current
5.2 – Electric Strength

ACS Report No.: 15-0004.S11.1B
Report Issue Date: April 22, 2015

Tested by:

Rylan London

Reviewed by:

D.C. Massey

This report contains 11 pages

REVISION HISTORY			
DATE	REVISION	DESCRIPTION	APPROVED BY
01/06/2015	A	Initial release.	D.C. Massey
4/22/2015	B	Made correction to model name on page 4 (from Helix 7 GPS to Helix 7 SI GPS), per client request.	D.C. Massey

Contents

GENERAL INFORMATION

1.0 Introduction

This report documents the results of testing performed on January 05, 2015 on the Johnson Outdoors model Helix 7 SI GPS recreational chartplotter.

Testing was performed to evaluate the EUT with regard to the requirements of the specific clauses of standard EN 60950-1:2006. Only these clauses were tested, at the request of the client.

4.5.4	Touch Temperature Limits
5.1	Touch Current
5.2	Electric Strength

This report should not be considered to fulfill all requirements of standard EN 60950-1:2006. A complete evaluation and test program was not conducted.

2.0 Test Facilities & Environment

2.1 Test Facilities

All testing was performed at the following address:

Advanced Compliance Solutions, Inc.
5015 B.U. Bowman Drive
Buford GA 30518
Phone: (770) 831-8048
Fax: (770) 831-8598
www.acstestlab.com

The laboratory is fully equipped to carry out the tests outlined in this report.

2.2 Laboratory Accreditations/Recognitions/Certifications

ACS is accredited to ISO/IEC 17025 by the National Institute of Standards and Technology under their National Voluntary Laboratory Accreditation Program (NVLAP).

2.3 Test Equipment Calibration Statement

Test equipment used for each test is specified in the relevant sections of this test report. Unless expressly given, all test equipment is calibrated on an annual basis, where applicable. All test equipment is operated within the climatic specifications as defined by the equipment manufacturer.

3.0 Equipment Under Test (EUT) Information

Manufacturer:
Johnson Outdoors
1220 Old Alpharetta Road
Suite 340
Alpharetta, GA 30005

Model: Helix 7 SI GPS

Description: Recreational chartplotter

Rated input voltage: 12 Vdc nominal

Maximum rated ambient operating temperature: 60°C

TEST RESULTS *per clause:*

4.5.4 Touch temperature limits

Accessible surfaces of the EUT shall not exceed 95 °C for plastic surfaces, 80 °C for glass surfaces, or 70 °C for metal surfaces, when the EUT is operated at the maximum rated ambient operating temperature. The limits are taken from EN 60950-1 Table 4C.

Test Equipment Used

Asset ID	Manufacturer	Model	Description	Last cal date	Cal due date
391	Hewlett Packard	34970A	Datalogger	2014-07-12	2015-07-12
289	Agilent	34901A	Datalogger module, 20 channel	2014-07-13	2015-07-13
439	DC Source	EZ Digital Co. LTD	GP-4303DU/TP	NCR	NCR
171	Greenlee	DM110	DMM	2014-07-10	2016-07-10
140	Thermotron	SM-16C	Environmental test chamber	2014-07-25	2015-07-25

NCR = No Calibration Required

Test Site Description

The EUT was tested in an environmental test chamber which controlled the ambient temperature.

Test Methodology

The EUT was configured and connected to satisfy its functional requirements. The EUT was powered by a DC source whose output voltage was monitored by a DMM. Temperatures on operator accessible surfaces of the EUT were monitored using 30 AWG Type T thermocouples and recorded using a datalogger. The EUT was operated in the required ambient until thermal stabilization was reached.

The input voltages to the EUT were 10.5 Vdc and 14.2 Vdc, to simulate a typical 12 Vdc nominal marine battery at “dead battery” and “battery charging” conditions.

Test Justification

☒ **No justification - The EUT was tested per the appropriate test methods and test plan.**
☐ **The test method, standard, and/or test plan was deviated from for the following reason:**

Test Results: See following pages

THERMOCOUPLE LOCATIONS

Channel	Location
1	Ambient
2	Screen center
3	Front right side
4	Top side, center
5	Top side, right
6	Right side
7	Left side
8	Bottom
9	Bottom, by nameplate
10	Rear, below connectors
11	Rear, left side
12	Rear, near top
13	Rear, left side
14	Rear, right side
15	Rear, top right


6


7


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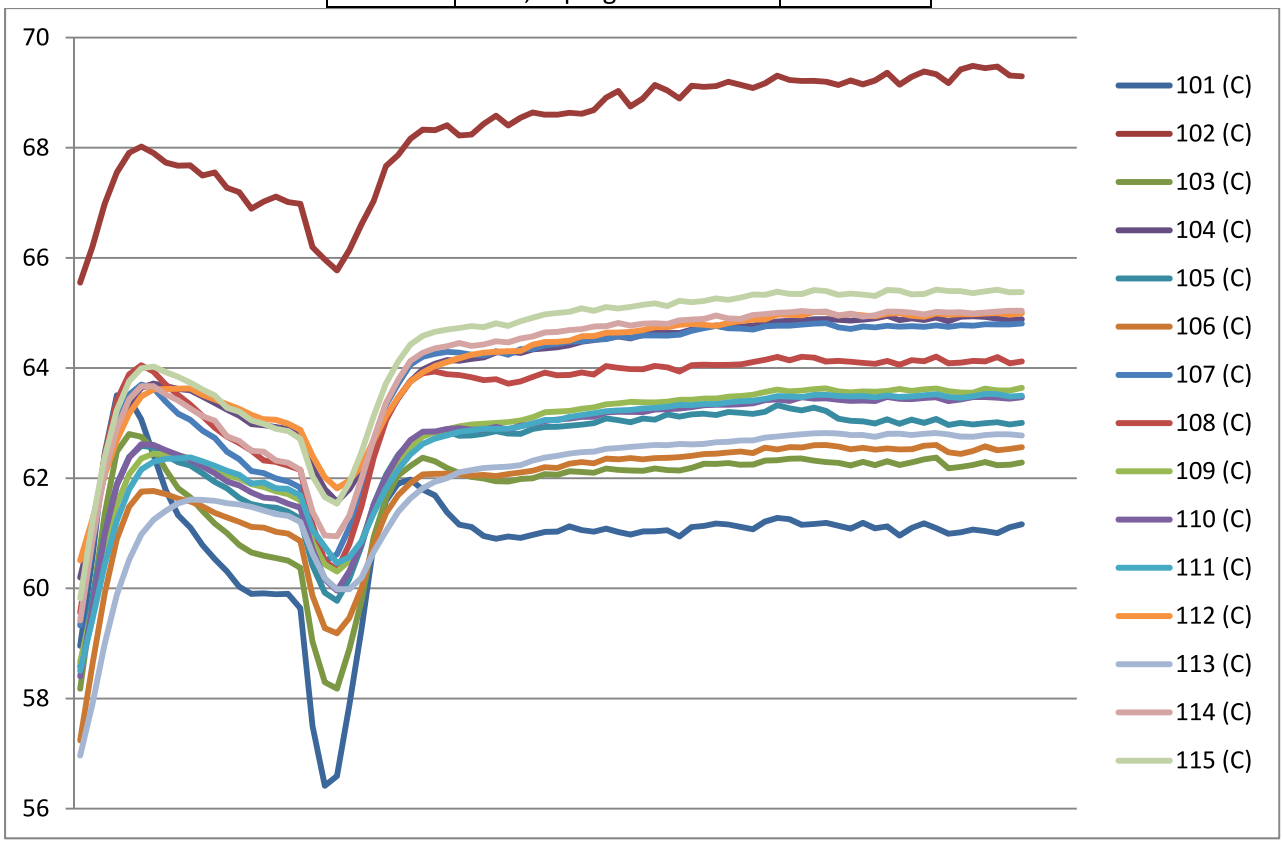
Test Results at 60˚C Ambient **Input Voltage: 10.5 VDC**

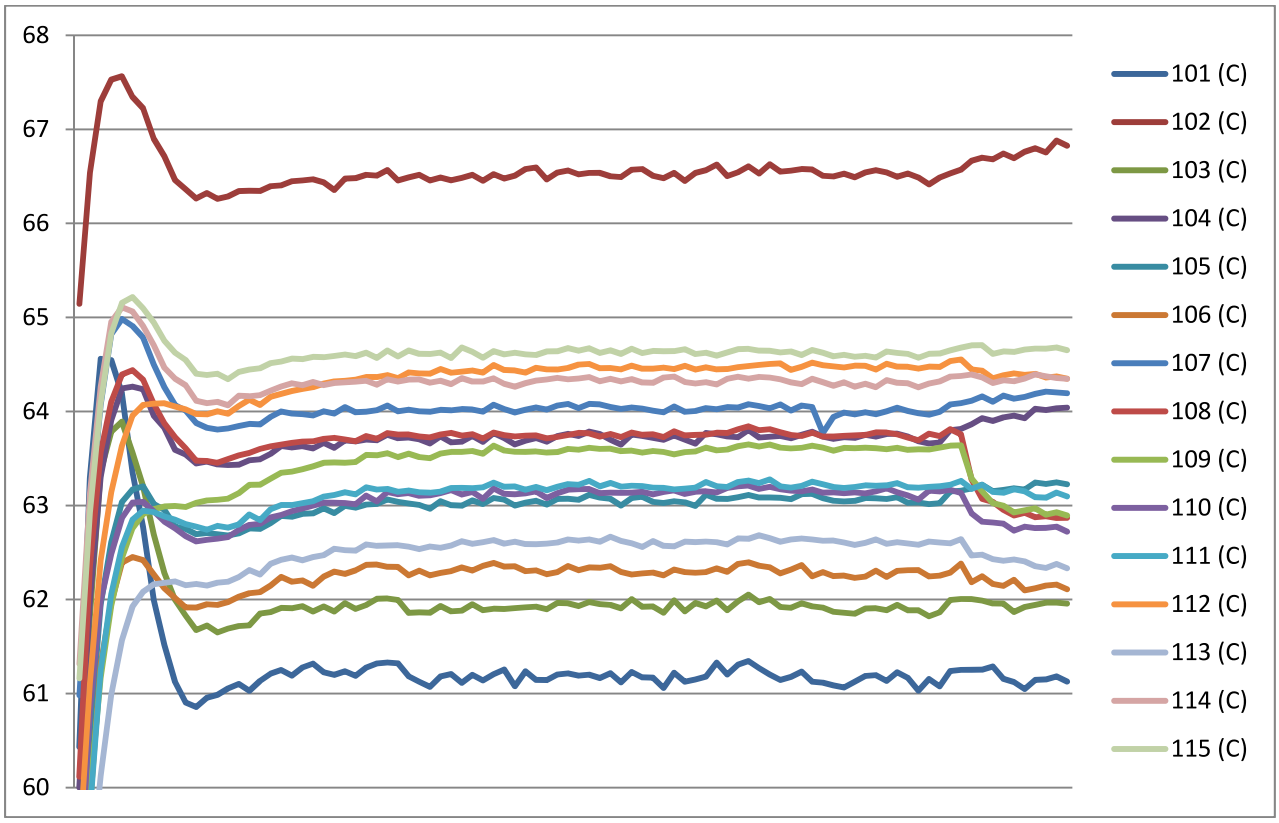
Channel	Location	Temp, °C
1	Ambient	61.16
2	Screen center	69.30
3	Front right side	62.28
4	Top side, center	64.88
5	Top side, right	63.01
6	Right side	62.56
7	Left side	64.81
8	Bottom	64.12
9	Bottom, by nameplate	63.64
10	Rear, below connectors	63.47
11	Rear, left side	63.50
12	Rear, near top	64.99
13	Rear, left side	62.78
14	Rear, right side	65.04
15	Rear, top right	65.38



Run Time: 1.28 hours

Test Results at 60˚C Ambient **Input Voltage: 14.2 VDC**

Channel	Location	Temp, °C
1	Ambient	61.13
2	Screen center	66.83
3	Front right side	61.96
4	Top side, center	64.04
5	Top side, right	63.23
6	Right side	62.11
7	Left side	64.19
8	Bottom	62.87
9	Bottom, by nameplate	62.89
10	Rear, below connectors	62.72
11	Rear, left side	63.10
12	Rear, near top	64.35
13	Rear, left side	62.33
14	Rear, right side	64.35
15	Rear, top right	64.65



Run Time: 1.55 hours

5.1 Touch current

Touch current was measured using a touch current meter complying with EN 60950-1:2006 Annex D, Figure D1.

Test Equipment Used

Asset ID	Manufacturer	Model	Description	Last cal date	Cal due date
439	DC Source	EZ Digital Co. LTD	GP-4303DU/TP	NCR	NCR
171	Greenlee	DM110	DMM	2014-07-10	2016-07-10
231	Simpson	228	Touch current meter	2014-07-13	2015-07-13

NCR = No Calibration Required

Test Site Description

The EUT was tested on the bench in normal laboratory ambient conditions.

Test Methodology

The EUT was configured and connected to satisfy its functional requirements. The EUT was powered by a DC source whose output voltage was monitored by a DMM. The input voltage to the EUT was 12 Vdc.

Touch current between the +12 Vdc input and the enclosure, covered in foil, was measured.

Test Justification

☐ **No justification - The EUT was tested per the appropriate test methods and test plan.**
☒ **The test method, standard, and/or test plan was deviated from for the following reason:**

Test performed at client request. EN 60950-1:2006 clause 5.1 states that touch current limits do not apply to DC powered equipment having no connection to wired telecommunication networks.

Test Result:

Measured touch current: 0 mA_{RMS}

5.2 Electric strength

Functional insulation between internal circuits and accessible parts was stressed by the application of a 500 V_{RMS} 60Hz test voltage between the +12 Vdc input pin and the non-conductive surface of the enclosure, covered by metal foil measuring 100mm x 200mm, in close contact with the enclosure.

The test voltage was raised gradually, and applied for one minute.

The EUT is not powered on during the test. Functional insulation between internal circuits, such as between +12 Vdc and DC Return were not tested, and not evaluated according to clause 5.3.4.

Test Equipment Used

Asset ID	Manufacturer	Model	Description	Last cal date	Cal due date
160	Associated Research	3665	Hi-pot tester	2014-07-13	2015-07-13

NCR = No Calibration Required

Test Site Description

The EUT was tested on the bench in normal laboratory ambient conditions.

Test Methodology

Per EN 60950-1:2006, clause 5.2, for Functional Insulation.

Test Justification

☒ **No justification - The EUT was tested per the appropriate test methods and test plan.**
☐ **The test method, standard, and/or test plan was deviated from for the following reason:**

Test Result: PASS

No breakdown of insulation

END OF TEST REPORT