For Scope of Accreditation Under Certificate Number: AT-2021

EMI Technical Report

Prepared For: Johnson Outdoors Marine Electronics, Inc.
KC ID: MSIP-REM-Jom-H7G2

Base Model: HELIX 7 CHIRP SI GPS G2
Model Variants: HELIX 7X CHIRP DI G2, HELIX 7X CHIRP GPS G2, HELIX 7X CHIRP DI GPS G2

Product Type: Sonar Fish Finder
Product Category: Information Technology Equipment

In Accordance with the
Conformity Assessment Procedure for Electromagnetic Interference
(RRA Announce 2015-110, Dec 3, 2015)

EMI Product Standard: Annex 8-1 (KN 301 489-1), Annex 8-8 (KN 301 489-3)

ACS Report: 16-0277.C07.8B
Report Revision: B
Report Issue Date: October 7, 2016

Project Manager:

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Advanced Compliance Solutions, Inc.

Reviewed by:

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Advanced Compliance Solutions, Inc.

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

This report contains 16 pages

REVISION HISTORY

Report Number: 16-0277.C07.8B
Manufacturer: Johnson Outdoors Marine Electronics, Inc.
Model: HELIX 7 CHIRP SI GPS G2

DATE	OLD REVISION	NEW REVISION	REASON	PAGES AFFECTED	APPROVED BY
July 14, 2016	---	A	Initial Release	All	Forrest Duncan
October 7, 2016	A	B	Added KC ID	1	Sam Wismer

Project Information

ACS Project: 16-0277.C07.8B

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: Seth Bergman

Phone: 334-687-6613
Fax:
Email: sbergman@johnsonoutdoors.com

Sample Information

Model: HELIX 7 CHIRP SI GPS G2 (410310-1M)
Model Variant(s): Model Variants:
Environment of Use: Residential
Sample Receive Date: June 20, 2016
Sample Receive Condition: Good
Test Mode Description: Battery Powered; GPS Active; Sonar mode measuring 6ft
Highest Data Rate: 1.575GHz
Source: GPS Receiver

Product Description

The Humminbird Helix 7 Gen 2 is a Sonar/Fishfinder product to be used in the marine environment. Product has a 7" display, 10 keypad buttons and displays Sonar return information on the screen. The device is mounted on the main deck/consoles of small recreational vessels in an exposed environment (directly exposed to the weather).

The model variants are defined as follows, per the manufacturer:
- HELIX 7X CHIRP DI G2 (410280-1M)
- HELIX 7X CHIRP GPS G2 (410290-1M)
- HELIX 7X CHIRP DI GPS G2 (410300-1M)

Test Information

Test Start Date: June 20, 2016
Test End Date: June 24, 2016
Emissions Pre-scan Site: SAC
Final Emissions Site: SAC
EMI Freq. Band: 150kHz - 6GHz
Radiated Emissions Equipment Class: Class B

Test Methods/Standards Applied

(Check all that apply):

☒ RRA Public Notification 2015-27 Dec 3, 2015**:** Korea Technical Requirements for Electromagnetic Compatibility

☒ KN 301 489-1 (Annex 8-1), KN 301 489-3 (Annex 8-8) Test Methods for Electromagnetic Compatibility with RRA Announce 2015-110 (Dec 3, 2015)

Table of Contents

1.0 Introduction

1.1 Scope

This report documents conformance with the Electromagnetic Interference requirements outlined in the product information sheet and details the results of testing performed on June 20, 2016 through June 24, 2016 on the model HELIX 7 CHIRP SI GPS G2 manufactured by Johnson Outdoors Marine Electronics, Inc..

1.2 Performance Criteria

For model HELIX 7 CHIRP SI GPS G2 the limits which apply are Class B. These limits are found in Table 1.2-1 below:

Table 1.2-1 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 0.5	84 to 74 (V)[1,2] 40 to 30 (I)[1,3]	74 to 64 (V)[1,2] 30 to 20 (I)[1,3]
	0.5 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

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 the project information section on page 3.

2.2 Laboratory Accreditations/Recognitions/Certifications

ACS is accredited to ISO/IEC 17025 by the ANSI-ASQ National Accreditation Board/ANAB accreditation program, and has been issued certificate number AT-2021 in recognition of this accreditation. Unless otherwise specified, all tests methods described within this report are covered under the ISO/IEC 17025 scope of accreditation.

ACS has been designated through NIST (US Identification Number: US0156) as a Phase I CAB under the APECTel MRA to perform testing for:

- Chinese Taipei's (Taiwan) Bureau of Standards, Metrology and Inspection: BSMI Number SL2-IN-E-1127R
- Hong Kong's Office of the Telecommunications Authority (OFTA)
- Singapore's Infocomm Development Authority of Singapore (IDA)
- Australia's Australian Communication and Media Authority (ACMA)

ACS has been recognized by the Radio Research Agency (RRA) Korea Communications Commission (KCC) under the Asian Pacific Economic Cooperation Mutual Recognition Arrangement (APEC Tel MRA). ACS is designated to act as a Conformity Assessment Body (CAB) under Appendix B, Phase 1 procedures of the aforementioned MRA.

ACS test sites are also designated by Japan's Voluntary Control Council for Interference (VCCI) to perform testing in accordance with VCCI technical regulations. The VCCI has issued the following designation code in recognition of these test sites: A-0152.

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 ambient temperature range of 40°F to 104°F.

3.0 Equipment Under Test (EUT)

3.1 Manufacturer

Johnson Outdoors Marine Electronics, Inc.
678 Humminbird Lane
Eufaula, AL 36027
Seth Bergman
334-687-6613
sbergman@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 <u>were not</u> required to bring the EUT into compliance with the requirements.**
☐ **Modifications <u>were</u> required to bring the EUT into compliance with the requirements.**

3.3 System Block Diagram and Support Equipment

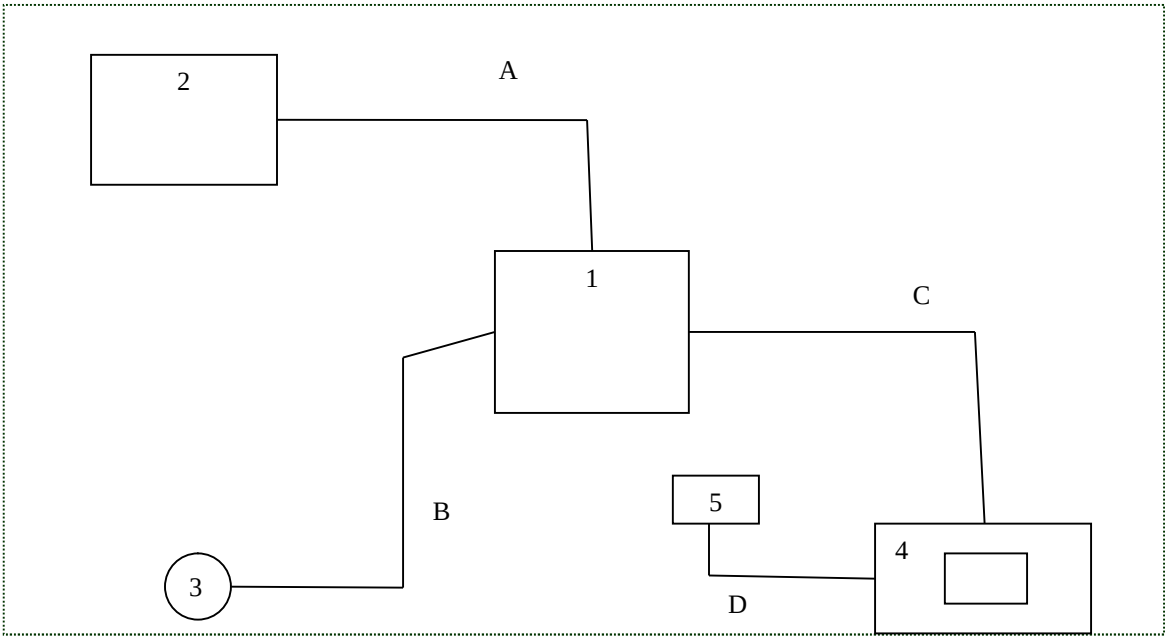

Figure 3.3-1: System Block Diagram

Table 3.3-1: EUT and Support Equipment Description

Item #	Type Device	Manufacturer	Model/Part #	Serial #
1	GPS Display	Humminbird	Helix 7 Gen. 2	N/A
2	12V Battery	AutoCraft	24DC-1	N/A
3	GPS Puck	Humminbird	N/A	12062742-0043
4	Transducer	Humminbird	N/A	N/A
5	Depth simulator	Humminbird	N/A	N/A

Table 3.3-2: Cable Description

Cable #	Cable Type	Length	Shield	Termination
A	Power Cable	100 cm	Not Shielded	1 - 2
B	GPS Cable	605 cm	Not Shielded	1 - 3
C	Transducer Cable	600 cm	Not Shielded	1 - 4
D	Coax Cable	35 cm	Not Shielded	4 - 5

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

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:

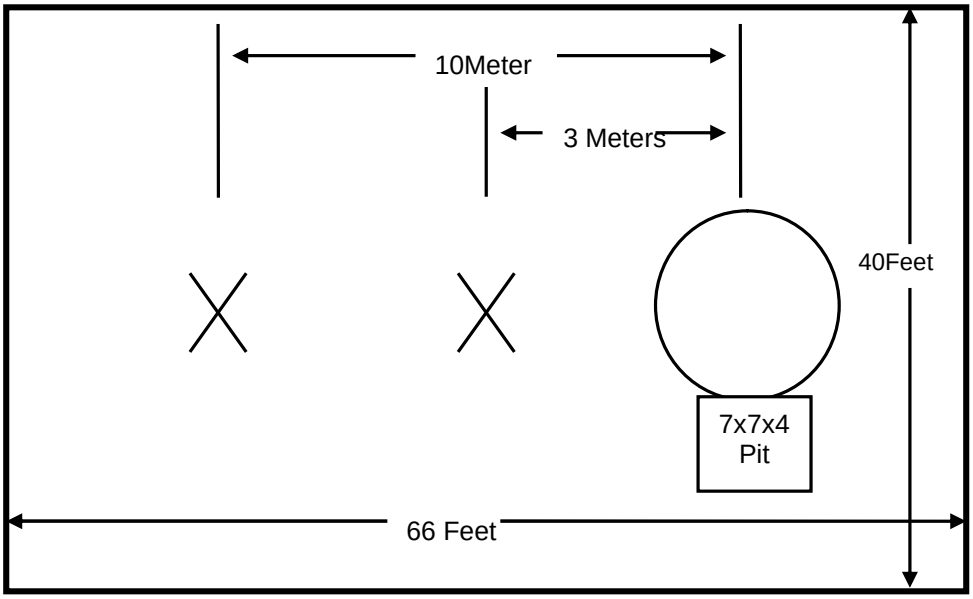

Figure 4.1.1.1-1: Open Area Test Site

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 4, 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:

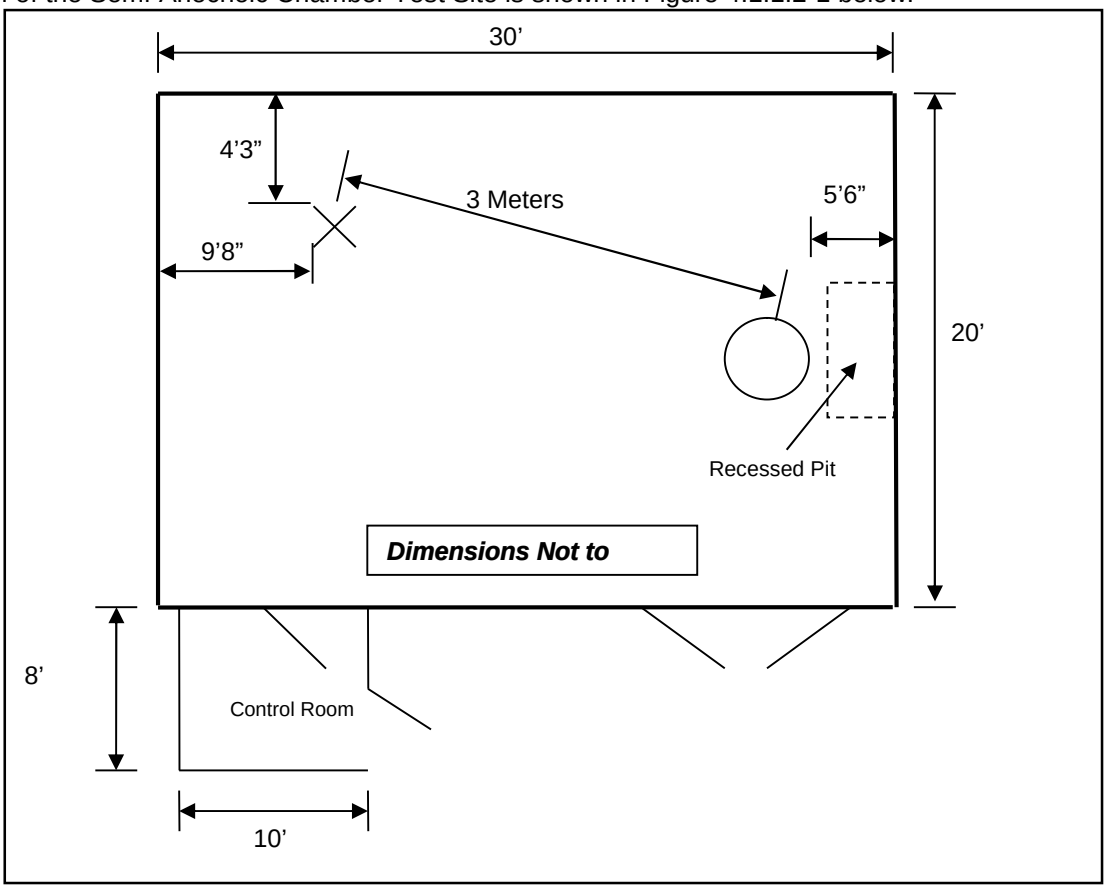

Figure 4.1.1.2-1: Semi-Anechoic Chamber Test Site

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 EUTs, 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:

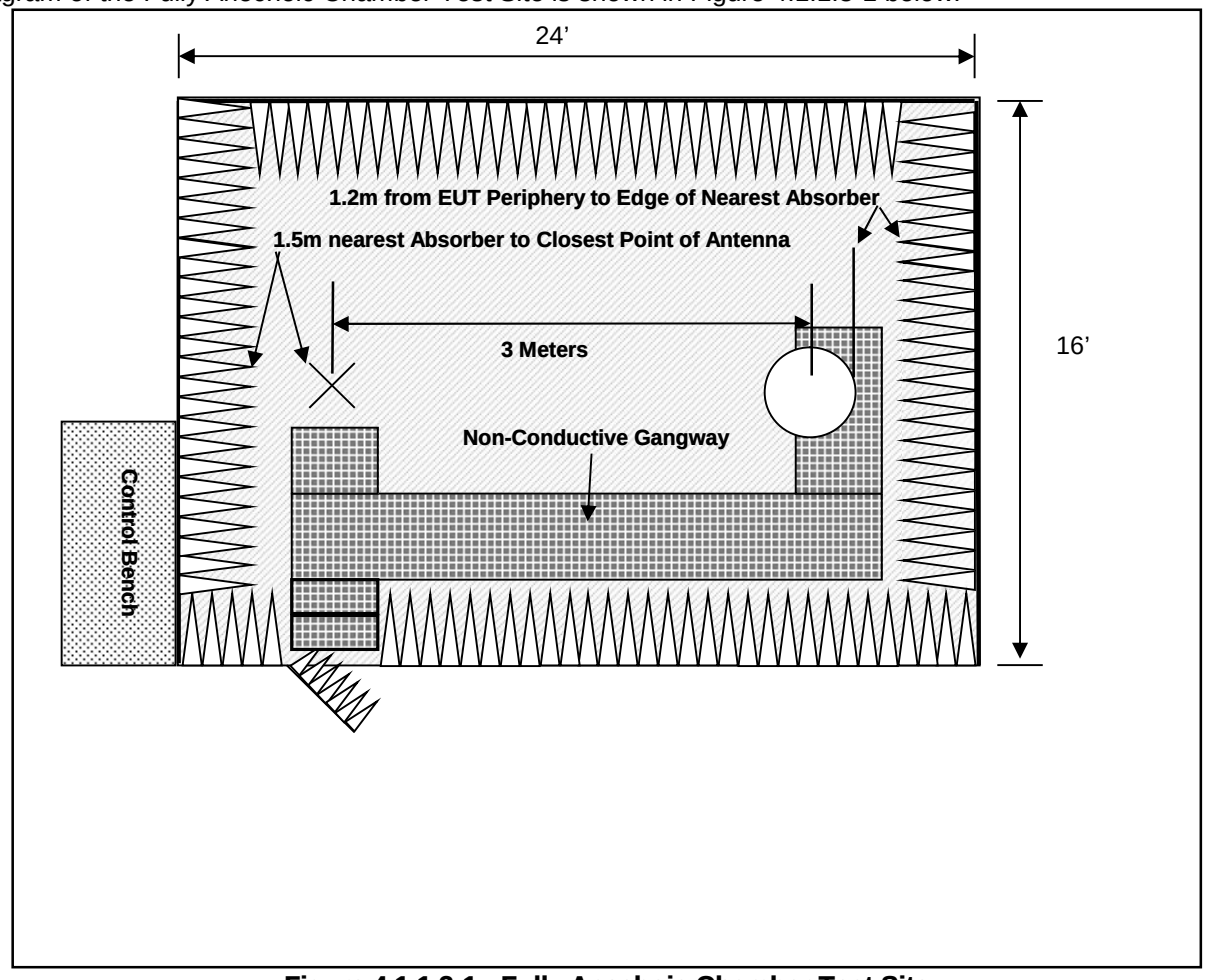

Figure 4.1.1.3-1: Fully Anechoic Chamber Test Site

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	7/14/2015	7/14/2016
2	Rohde & Schwarz	ESMI-Receiver	Spectrum Analyzers	839587/003	7/14/2015	7/14/2016
73	Agilent	8447D	Amplifiers	2727A05624	7/15/2015	7/15/2016
338	Hewlett Packard	8449B	Amplifiers	3008A01111	8/21/2015	8/21/2017
30	Spectrum Technologies	DRH-0118	Antennas	970102	4/30/2015	4/30/2017
40	EMCO	3104	Antennas	3211	6/8/2016	6/8/2018
412	Electro Metrics	LPA-25	Antennas	1241	7/24/2014	7/24/2016
616	Florida RF Cables	IRE-200W-12.0-SM	Cables	N/A	9/3/2015	9/3/2016
422	Florida RF	MS-200AW-72.0-SM	Cables	805	10/30/2015	10/30/2016
167	ACS	hamber EMI Cable S	Cable Set	167	10/20/2015	10/20/2016

NCR = No Calibration Required

4.1.3 Test Methodology

4.1.3.1 Pre-Scans

Radiated pre-scans are performed on all EUTs 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 4.1.1.1. Final emission testing on Class B equipment can be performed either in the 3m Semi-Anechoic chamber described in section 4.1.1.2 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 to 18GHz. 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 A Limits as given in table 1.2-1.

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

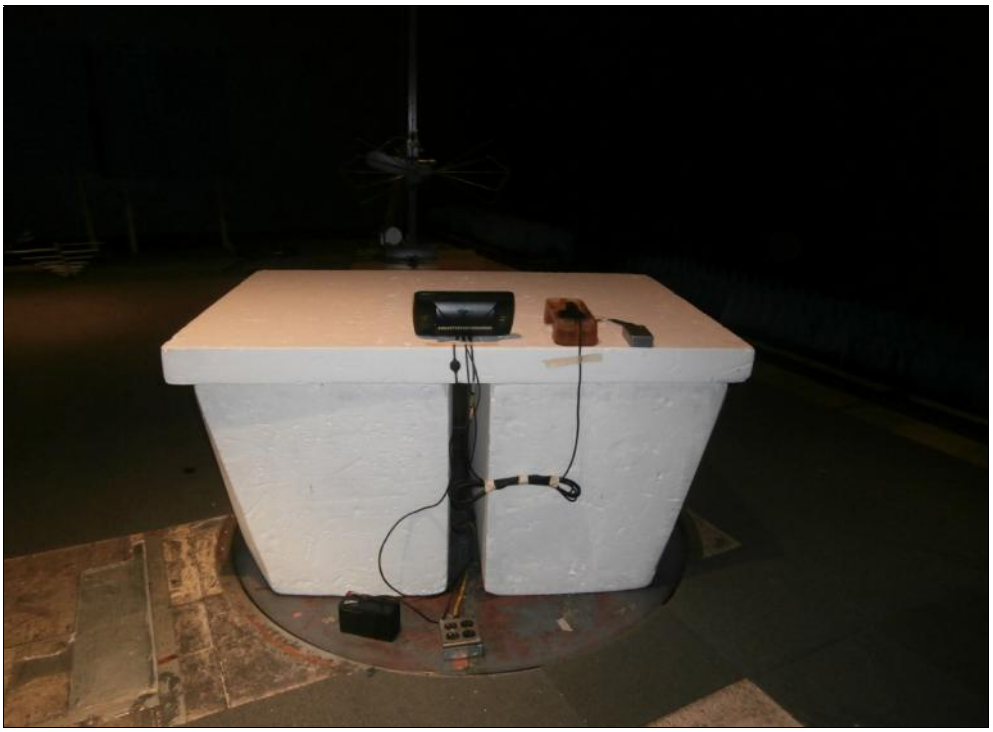

Figure 4.1.4-2: Radiated Emissions - Rear View

4.1.5 Test Data

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

Test Parameters:

Test Date:	**June 20, 2016**	**Temperature (ºC)**	**26**
Technician:	**Art Sumner**	**Humidity (%)**	**34**
Equipment Class:	**Class B**	**Barometric Pressure (mBar)**	**1023**
Tested Modes:	**GPS active; Sonar mode measuring 6ft**		
AC Input Power:	**N/A**		
DC Input Power:	**12Vdc**		

Test Data Table:

Measurement Distance:

☐ **FAC** ☒ **SAC** ☐ **OATS**
☐ **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
39.82		48.49	v	100	0	-13.99	---------	34.50	--------	40.5	---------	6.0
40.116		48.92	V	100	105	-14.00	---------	34.92	--------	40.5	---------	5.5
40.76		48.92	v	100	5	-14.02	---------	34.90	--------	40.5	---------	5.6
41.14		50.52	V	100	5	-14.02	---------	36.50	--------	40.5	---------	4.0
43.41		50.70	v	100	5	-14.07	---------	36.63	--------	40.5	---------	3.8
90.86		38.08	V	100	355	-13.75	---------	24.33	--------	40.5	---------	16.1

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

Notes:
There were no significant emissions found 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:**

This test is not applicable, because the EUT is not powered through an AC Mains power supply and it does not have any telecom ports.

5.0 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:

Table 5.0-1: Values of U_{cispr} and U_{Lab}

Measurement	U_{cispr}	U_{Lab}
Conducted disturbance (mains port) (9 kHz – 150 kHz) (150 kHz – 30 MHz)	 4,0 dB 3,6 dB	2.54 dB
Radiated disturbance (electric field strength on an open area test site or alternative test site) (30 MHz – 1 000 MHz)	 5,2 dB	3.93 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.

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.

6.0 Conclusion

The EUT is determined to meet the requirements as defined in the applicable regulations.