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EMI Test Report

In Accordance with:

**FCC 47 CFR Part 15 Subpart B
ISED Canada ICES-003 Issue 6**

Authorization Type: Verification

Manufacturer: Johnson Outdoors, Inc.

Model Covered: HELIX 7 CHIRP GPS G3

**Model Variants: HELIX 7 CHIRP GPS G3, HELIX 7X CHIRP GPS G3,
HELIX 7 CHIRP MDI, GPS G3, HELIX 7X CHIRP MDI GPS G3,
HELIX 7 CHIRP MSI GPS G3, HELIX 7X, CHIRP MSI GPS G3,
HELIX 7 CHIRP GPS G3N, HELIX 7X CHIRP GPS G3N,
HELIX 7 CHIRP MDI GPS G3N, HELIX 7X CHIRP MDI GPS G3N,
HELIX 7 CHIRP MSI GPS G3N, HELIX 7X CHIRP MSI GPS G3N,
ICE HELIX 7 CHIRP GPS G2N**

Report Number: AT72141218.1V0

Report Revision: A

Report Issue Date: October 23, 2018

This report contains Page 21 pages



America

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Sean Vick
EMC Team Lead
TÜV SÜD America Inc.

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TÜV SÜD America Inc. The results contained in this report are representative of the sample(s) submitted for evaluation.

REVISION HISTORY

Report Number: AT72141218.1V0
Manufacturer: Johnson Outdoors, Inc.
Model: HELIX 7 CHIRP GPS G3

Project Information

Applicant Details

Manufacturer: Johnson Outdoors, Inc.
Street Address: 1220 Old Alpharetta Road
Suite 340
City, State/Province and Postal Code:
Alpharetta, GA 30005
Country: USA
Contact: Kim Lincoln

Phone: +177088862921076
Fax:
Email: Kim.Lincoln@johnsonoutdoors.com

Sample Information

Model: HELIX 7 CHIRP GPS G3
Model Variant(s): HELIX 7 CHIRP GPS G3, HELIX 7X CHIRP GPS G3, HELIX 7 CHIRP MDI, GPS G3, HELIX 7X CHIRP MDI GPS G3,
HELIX 7 CHIRP MSI GPS G3, HELIX 7X, CHIRP MSI GPS G3,
HELIX 7 CHIRP GPS G3N, HELIX 7X CHIRP GPS G3N, HELIX 7 CHIRP MDI GPS G3N, HELIX 7X CHIRP MDI GPS G3N,
HELIX 7 CHIRP MSI GPS G3N, HELIX 7X CHIRP MSI GPS G3N,
ICE HELIX 7 CHIRP GPS G2N
Environment of Use: Residential
Sample Receive Date: August 13, 2018
Sample Receive Condition: Good
Test Mode Description: Powered ON; displaying depth, speed, and coordinates
Highest Frequency Generated or Used: Not provided

Source: Not provided

Product Description

The Helix 7 is a Sonar/Fish finder/GPS product to be used in a marine environment.

The test unit has a 7" display and 13 keypad buttons. It also has 1 SD card slot and displays 2D SI and DI Sonar return information on the display. The unit is also Bluetooth and BLE capable and also has a 10/100 Ethernet connection port on the back. This unit has the same Housing, micro, memory, power, GPS module and BT/BLE module as the Helix 7 G2N. Some differences in receiver and display

Helix 7X Chirp MDI GPS G3N – same as main unit but only supports 2D and MDI sonar

Helix 7X Chirp GPS G3N – same as main but only supports 2D sonar

ICE Helix 7 Chirp GPS G2N – same as main but supports only 2D sonar and accessories applicable for ice fishing

Helix 7X Chirp MSI GPS G3 same as main unit without BT/BLE or Ethernet

Helix 7X Chirp MDI GPS G3 same as main only 2D and DI sonar w/o BT/BLE or Ethernet

Helix 7X Chirp GPS G3 – same as main unit but 2D sonar only and no BT/BLE and Ethernet

ICE Helix 7 Chirp GPS G2 FB – same as main with only 2D sonar & ice fishing accessories __w/o BT/BLE or Ethernet

Test Information

Test Start Date: August 13, 2018

Test End Date: August 13, 2018

Emissions Pre-scan Site: SAC

Final Emissions Site: SAC

EMI Freq. Band: 30MHz-18GHz

Radiated Emissions Equipment

Class: Class B

Test Methods/Standards Applied

US Code of Federal Regulations (CFR): Title 47, Part 15, Radio Frequency Devices, Subpart B, Unintentional Radiators.

ANSI C63.4-2014 - American National Standard for Methods of Measurement of Radio-Noise Emissions from low-voltage electrical and electronic equipment in the range of 9kHz to 40 GHz.

Innovation, Science and Economic Development (ISED) Canada ICES-003 Issue 6: Information Technology Equipment (Including Digital Apparatus) – Limits and methods of measurement

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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 August 13, 2018 through August 13, 2018 on the model HELIX 7 CHIRP GPS G3 manufactured by Johnson Outdoors, Inc..

1.2 Performance Criteria

For model HELIX 7 CHIRP GPS G3 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

FCC Limits		
Emission Type	Frequency Range ² (MHz)	Voltage limits ¹ (dBuV)
Conducted Class B	0.15 to .5	66 to 56 QP 56 to 46 Ave
	.5 to 5	56 QP 46 Ave
	5 to 30	60 QP 50 Ave
Radiated Class B @ 3 meters	30.0 to 88.0	40.0
	88.0 to 216.0	43.5
	216.0 to 960.0	46.0
	Above 960.0	54.0

1 - Decreases Linearly with Logarithm of Frequency

2 - Limits <1GHz are Quasi-Peak and Peak >1GHz

Note: Lower Limit Applies at Transition Frequency



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Report No: AT72141218.1V0

2.0 Test Facilities & Environment

2.1 Test Facilities

All testing was performed at the following address:

TÜV SÜD America Inc.
5945 Cabot Parkway
Suite 100
Alpharetta, GA 30005
Phone: (678) 341-5900
www.TUVamerica.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

TÜV SÜD America, Inc. is accredited to ISO/IEC 17025 by the American Association for Laboratory Accreditation/A2LA accreditation program and has been issued certificate number 2955.09 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.

TÜV SÜD America Inc. 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)

TÜV SÜD America Inc. 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-0295.

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.



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3.0 Equipment Under Test (EUT)

3.1 Manufacturer

Johnson Outdoors, Inc.
1220 Old Alpharetta Road Suite 340
Alpharetta, GA 30005
Kim Lincoln
+177088862921076
Kim.Lincoln@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

<input checked="" type="checkbox"/> Modifications <u>were not</u> required to bring the EUT into compliance with the requirements.
<input type="checkbox"/> Modifications <u>were</u> required to bring the EUT into compliance with the requirements.

3.3 System Block Diagram and Support Equipment

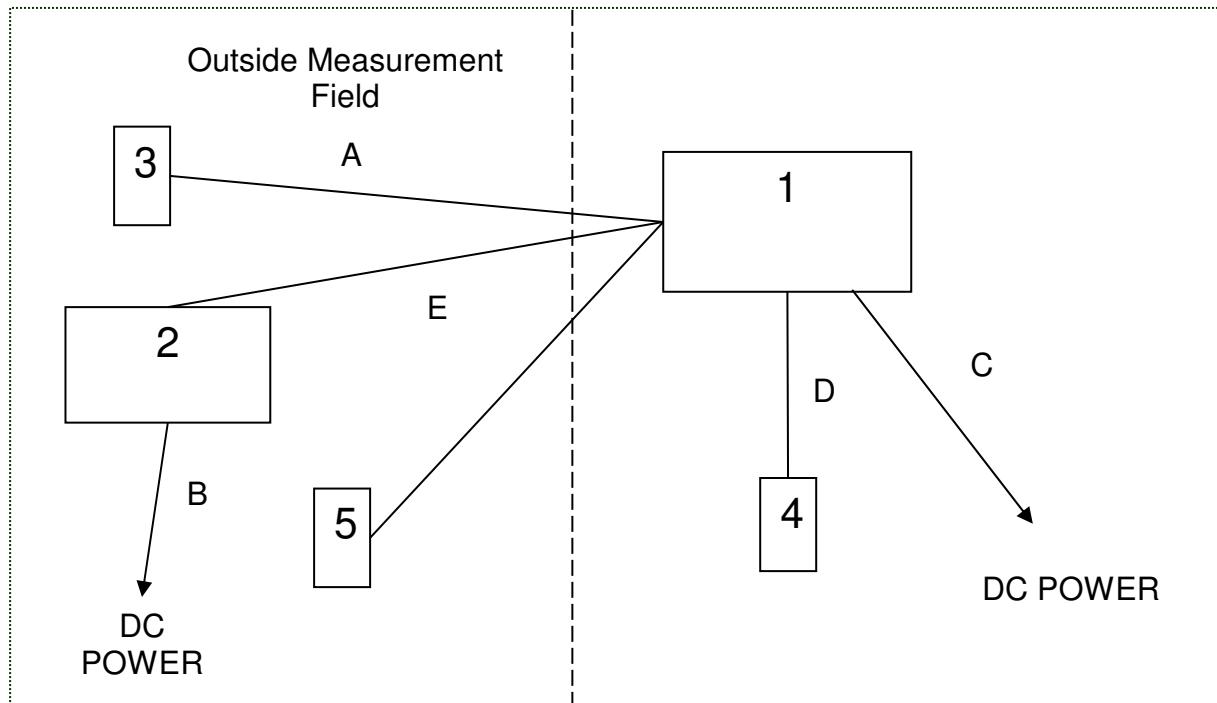


Figure 3.3-1: System Block Diagram

Table 3.3-1: EUT and Support Equipment Description

Item #	Type Device	Manufacturer	Model/Part #	Serial #
1	EUT	Johnson Outdoors	HELIX 7 CHIRP G3	N/A
2	Auxiliary Equipment	Johnson Outdoors	HELIX 7	180731223004
3	GPS antenna	Humminbird	AS*GPS HS	14121642-0035
4	Transducer	Johnson Outdoors	N/A	N/A
5	Speed sensor	Johnson Outdoors	N/A	N/A

Table 3.3-2: Cable Description

Cable #	Cable Type	Length	Shield	Termination
A	GPS	20'	No	1 - 3
B	DC leads	4'	No	2 - DC power
C	DC leads	5'	No	1 - DC power
D	Transducer cable	20'	No	1 - 4
E	Ethernet	30'	No	1 - 2



America

Model: HELIX 7 CHIRP GPS G3

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3.4 Observations

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

Table 3.4-1: Observations

<u>Observation No.</u>	<u>Description</u>

3.5 EUT Photographs



Figure 3.5-1: EUT Photo – Front



Figure 3.5-2: EUT Photo – Back

4.0 Radiated and Conducted Emissions

4.1 Radiated Emissions

4.1.1 Radiated Emissions Test Site

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:

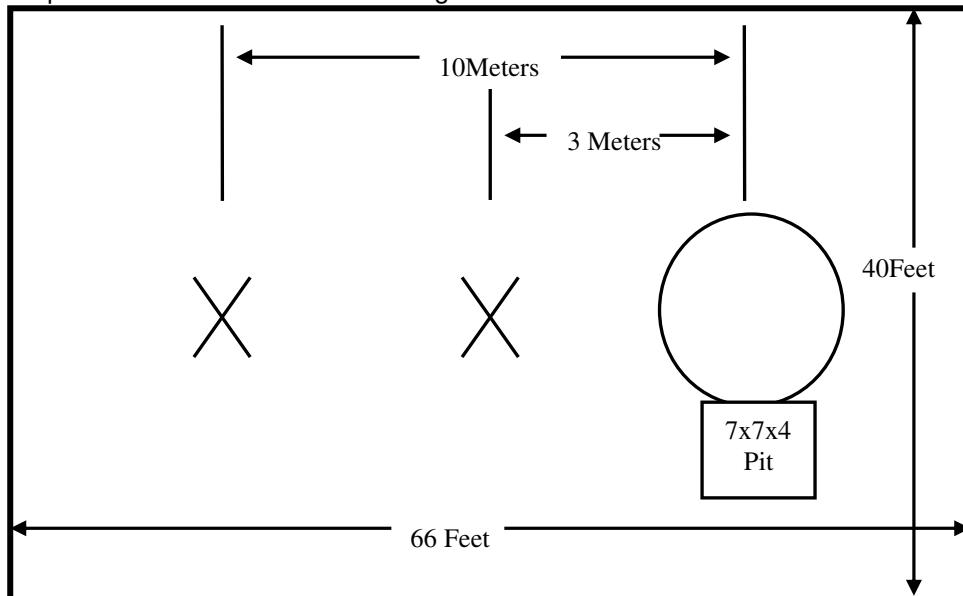


Figure 4.1.1.1-1: Open Area Test Site

4.1.1.2 Semi-Anechoic Chamber

The Semi-Anechoic Chamber Test Site consists of a 20'W x 30'L x 20'H shielded enclosure. The chamber is lined with ETS-Lindgren Ferrite Absorber, model number FT-1500. The ferrite tile 600 mm x 600 mm (2.62 in x 23.62 in) panels and are mounted directly on the inner walls of the chamber shield.

The specular regions of the chamber are lined with additional ETS-Lindgren PS-600 hybrid absorber to extend its frequency range up to 18GHz and beyond.

The turntable is a 2m ETS-Lindgren Model 2170, and installed off the center axis is located 5'6" 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 shield using #8 solid copper wire.

The antenna mast is an EMCO 1060 and is remotely controlled from the control room for both antenna height and polarization.

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

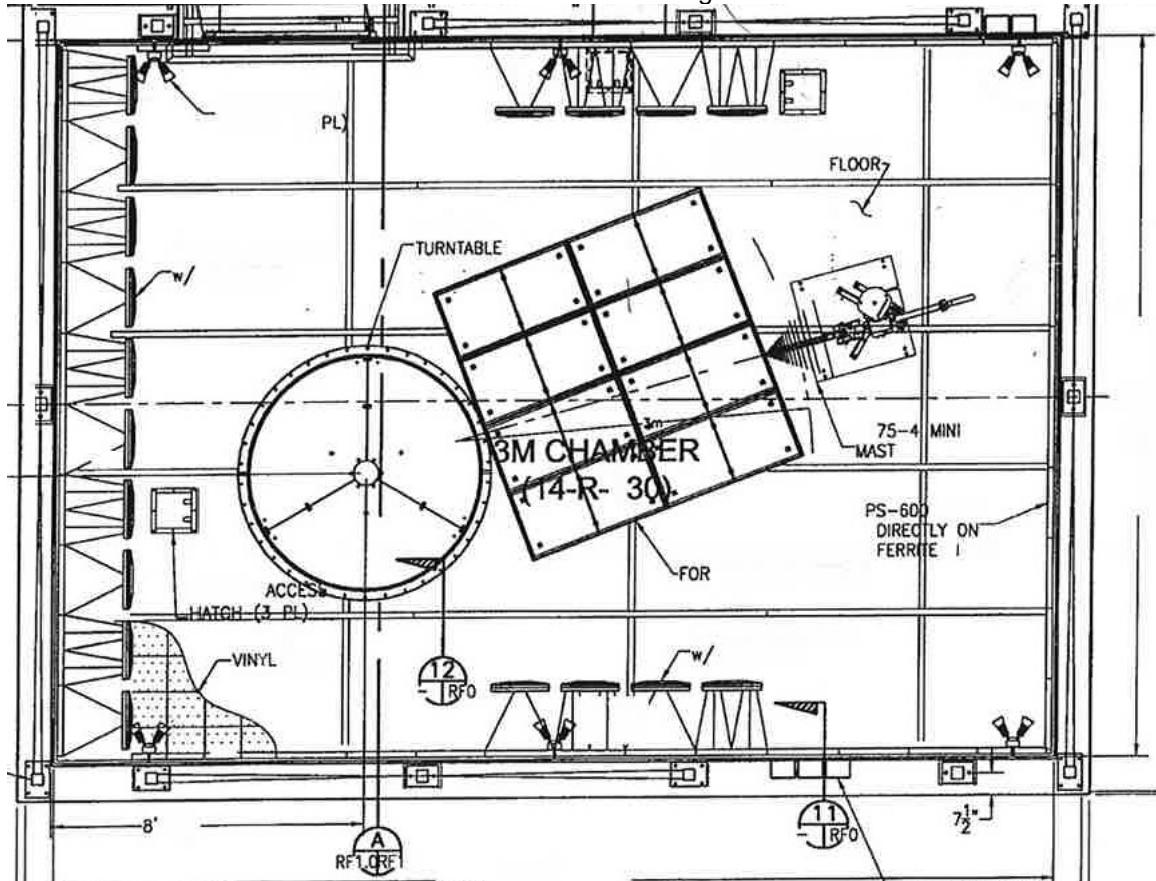


Figure 4.1.1.2-1: Semi-Anechoic Chamber Test Site

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:

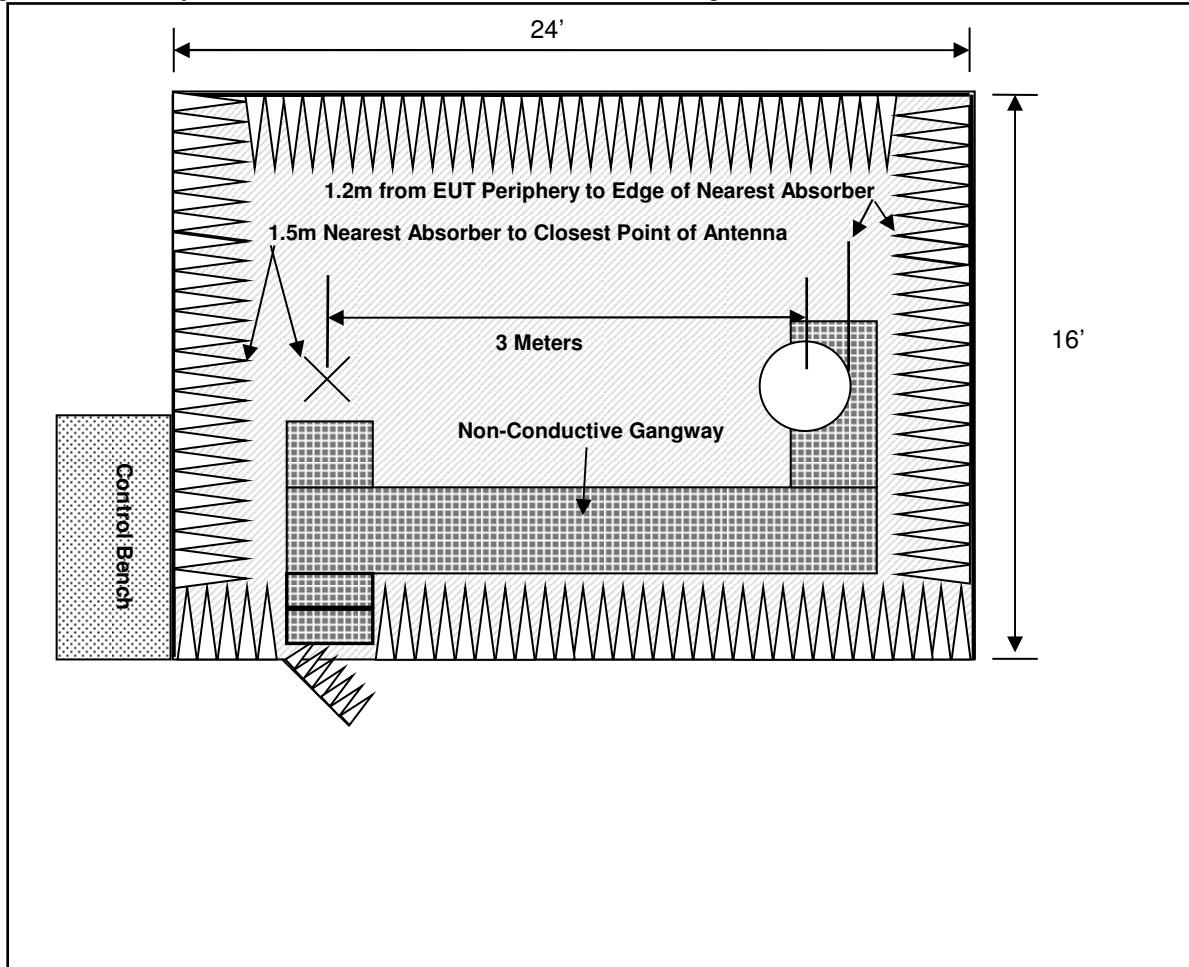


Figure 4.1.1.3-1: Fully Anechoic Chamber Test Site

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

Semi-Anechoic Chamber

AssetID	Manufacturer	Model#	Equipment Type	Serial#	Calibration Performed Date	Calibration Due Date
731	EMCO	3104	Antennas	2659	11/09/2016	11/09/2018
213	TEC	PA 102	Amplifiers	44927	7/19/2018	7/19/2019
836	ETS Lindgren	Chamber B EMI Cable Set	Cable Set	836	5/1/2018	5/1/2019
412	Electro Metrics	LPA-25	Antennas	1241	8/22/2018	8/22/2020
819	Rohde & Schwarz	ESR26	EMI Test Receiver	101345	10/31/2017	10/31/2018
90	Electro-metrics	LPA25	Antennas	1476	1/3/2018	1/3/2020
144	Omega	RH411	Climate Monitoring Equipment	H0103373	9/1/2016	3/11/2019

Semi-Anechoic Chamber High Frequency

AssetID	Manufacturer	Model#	Equipment Type	Serial#	Calibration Performed Date	Calibration Due Date
30	Spectrum Technologies	DRH-0118	Antennas	970102	5/9/2017	5/9/2019
338	Hewlett Packard	8449B	Amplifiers	3008A01111	7/11/2017	7/11/2019
836	ETS Lindgren	Chamber B EMI Cable Set	Cable Set	836	5/1/2018	5/1/2019
819	Rohde & Schwarz	ESR26	EMI Test Receiver	101345	10/31/2017	10/31/2018
144	Omega	RH411	Climate Monitoring Equipment	H0103373	9/1/2016	3/11/2019

NCR = No Calibration Required



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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 4.1.1.1. 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 90° 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-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 are taken above 1000MHz with the RBW set to 1MHz and VBW set to 10Hz. The calculation for the radiated emissions field strength is as follows:

$$\begin{aligned}\text{Corrected Reading} &= \text{Analyzer Reading} + \text{Cable Loss} + \text{Antenna Factor} - \text{Amplifier Gain} \\ \text{Margin(dB)} &= \text{Applicable Limit} - \text{Corrected Reading}\end{aligned}$$

4.1.3.3 Test Criteria

The EUT must meet the Class B Limits as given in section 1.2.

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:

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4.1.4 Test Setup Photographs

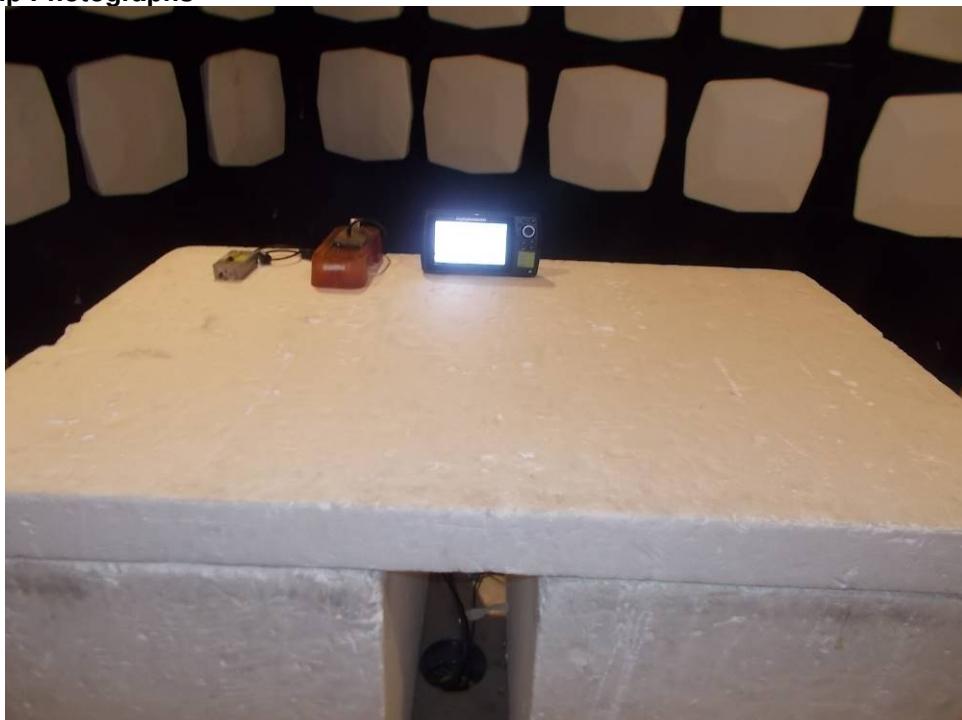


Figure 4.1.4-1: Radiated Emissions - Front View



Figure 4.1.4-2: Radiated Emissions - Rear View



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4.1.5 Test Data

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

Test Parameters:

Test Date:	August 13, 2018	Temperature (°C)	25
Technician:	Art Sumner	Humidity (%)	48
Equipment Class:	B	Barometric Pressure (mBar)	1017
Tested Modes:	Powered ON; GPS, speed sensor, and Aux Helix unit connected		
AC Input Power:	N/A		
DC Input Power:	12Vdc		

Test Data Table: FCC Limits

Measurement Distance:												
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
43.47	61.20	45.10	H	100	0	-13.33	-----	31.77	-----	40.0	-----	8.2
62	52.10	44.00	V	100	0	-13.02	-----	30.98	-----	40.0	-----	9.0
99.4	54.50	48.00	H	100	181	-11.52	-----	36.48	-----	43.5	-----	7.0
48.6	49.00	45.10	V	100	105	-13.16	-----	31.94	-----	40.0	-----	8.1
168.55	45.60	42.20	V	100	109	-6.93	-----	35.27	-----	43.5	-----	8.2
248.6	52.50	47.40	V	100	191	-10.12	-----	37.28	-----	46.0	-----	8.7
297.85	52.60	49.80	V	100	231	-9.76	-----	40.04	-----	46.0	-----	6.0

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

AV = Average Measurement or Limit (>1GHz)

Notes:



Model: HELIX 7 CHIRP GPS G3

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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:

EUT is powered by a DC battery. Conducted emissions testing was not required.

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 $(U_{\text{Lab}} - U_{\text{cispr}})$, exceeds the disturbance limit;
- non-compliance is deemed to occur if any measured disturbance, increased by $(U_{\text{Lab}} - U_{\text{cispr}})$, exceeds the disturbance limit.

The 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.