For Scope of Accreditation Under Certificate Number: 2955.09

America

Choose certainty.
Add value.

EMC Technical Report

Prepared For: JOHNSON OUTDOORS

Model Covered: HELIX 9 G3N
Model Variants: HELIX 9 CHIRP GPS G3N, HELIX 9X CHIRP GPS G3N, HELIX 9 MDI GPS G3N, HELIX 9X MDI GPS G3N, HELIX 9 MSI GPS G3N, HELIX 9X MSI GPS G3N, HELIX 8 CHIRP GPS G3N, HELIX 8X CHIRP GPS G3N, HELIX 8 MDI GPS G3N, HELIX 8X MDI GPS G3N, HELIX 8 MSI GPS G3N, HELIX 8X MSI GPS G3N

In Accordance with the:
Electromagnetic Compatibility Directive – 2014/30/EU

Immunity Product Standard: EN60945
Emissions Product Standard(s): EN60945

Report Number: 72141977.7E2
Report Revision: B
Report Issue Date: January 10, 2019

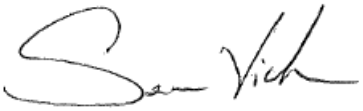
This report contains Page 50 pages

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

Project Manager:

Arthur Sumner
EMC Engineer
TÜV SÜD America Inc.

Reviewed by:



Sean Vick
EMC Team Lead
TÜV SÜD America Inc.

This report must not be used by the client to claim product certification, approval, or endorsement by A2LA, NIST, or any agency of the Federal Government.

REVISION HISTORY
Report Number: 72141977.7E2
Manufacturer: JOHNSON OUTDOORS
Model: HELIX 9 G3N

DATE	OLD REVISION	NEW REVISION	REASON	PAGES AFFECTED	APPROVED BY
December 3, 2018	---	A	Initial Release	All	Sean Vick
January 10, 2019	A	B	Removed watermark from page 1. Updated Page 4 Unacceptable Degradation. Fixed Error! Reference Source not found on page 19.	1, 4, 19	Sean Vick

Project Information Sheet

Applicant Details

Manufacturer: JOHNSON OUTDOORS
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 9 G3N
Model Variant(s): HELIX 9 CHIRP GPS G3N, HELIX 9X CHIRP GPS G3N, HELIX 9 MDI GPS G3N, HELIX 9X MDI GPS G3N, HELIX 9 MSI GPS G3N, HELIX 9X MSI GPS G3N, HELIX 8 CHIRP GPS G3N, HELIX 8X CHIRP GPS G3N, HELIX 8 MDI GPS G3N, HELIX 8X MDI GPS G3N, HELIX 8 MSI GPS G3N, HELIX 8X MSI GPS G3N
Environment of Use: Residential
Sample Receive Date: October 2, 2018
Sample Receive Condition: Good
Test Mode Description: Powered ON; Monitoring depth, speed, temp, GPS
Unacceptable Degradation (Provided by Mfg.): N/A
Highest Data Rate: 800MHz **Source:** Main processor

Product Description

Helix 9X Chirp MSI GPS G3N – main unit – supports 2D, MDI and MSI Sonar with GNSS receiver, BT/BLE and Ethernet port
Helix 9X Chirp MDI GPS G3N – same as main but MSI Sonar is disabled via software
Helix 9X Chirp GPS G3N – same as main unit but MSI and MDI Sonar disabled via software
Helix 8X Chirp MSI GPS G3N – same as main but with smaller screen
Helix 8X Chirp MDI GPS G3N – same as main but MSI Sonar is disabled via software, and smaller screen
Helix 8X Chirp GPS G3N – same as main but MSI and MDI Sonar is disabled via software, and smaller screen

Test Information

Test Start Date: October 2, 2018
Test End Date: October 26, 2018
Emissions Pre-scan Site: SAC
Final Emissions Site: OATS
EMI Freq. Band: 10KHz-18GHz
RFI Site: SAC
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. 2.0
☐ 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 EN60945 and details the results of testing performed on October 2, 2018 through October 26, 2018 on the model HELIX 9 G3N manufactured by JOHNSON OUTDOORS .

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	
IEC 60945:2002	Maritime navigation and radiocommunication equipment and systems – General requirements – Methods of testing and required test results	Pass
EN 61000-3-2:2014	Electromagnetic compatibility (EMC) -- Part 3-2: Limits - Limits for harmonic current emissions (equipment input current <= 16 A per phase)	N/A
EN 61000-3-3:2013	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 EN60945	
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. 2.0	Electromagnetic compatibility (EMC) - Part 4-4: Testing and measurement techniques - Electrical fast transient/burst immunity test	N/A
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 = Test Not Applicable to this EUT N/P = Not Performed. See Test Justification for Details

1.4 Performance Criteria

1.4.1 Emissions Performance Criteria

For model HELIX 9 G3N the limits which apply are EN60945 Class B. These limits are found in Table 1.4.1-1 below:

Table 1.4.1-1 Emissions Limits

	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		

1.4.4 Immunity Performance Criteria

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

Performance Criterion A: The apparatus shall continue to operate as intended. No degradation of performance or loss of function is allowed below a performance level specified by the manufacturer, when the apparatus is used as intended. The performance level may be replaced by a permissible loss of performance. If the minimum performance level or the permissible performance loss is not specified by the manufacturer, then either of these may be derived from the product description and documentation and what the user may reasonably expect from the apparatus if used as intended.

Performance Criterion B: The apparatus shall continue to operate as intended after the test. No degradation of performance or loss of function is allowed below a performance level specified the manufacturer, when the apparatus is used as intended. The performance level may be replaced by a permissible loss of performance. During the test, degradation of performance is however allowed. No change of actual operating state or stored data is allowed. If the minimum performance level or the permissible performance loss is not specified by the manufacturer then either of these may be derived from the product description and documentation and what the user may reasonably expect from the apparatus if used as intended.

Performance Criterion C: Temporary loss of function is allowed, provided the function is self recoverable or can be restored by the operation of the controls

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

TÜV SÜD America Inc.
5015 B.U. Bowman Drive
Buford GA 30518
Phone: (770) 831-8048
Fax: (770) 831-8598
www.TUVamerica.com

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

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. 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.

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
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

☒ **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

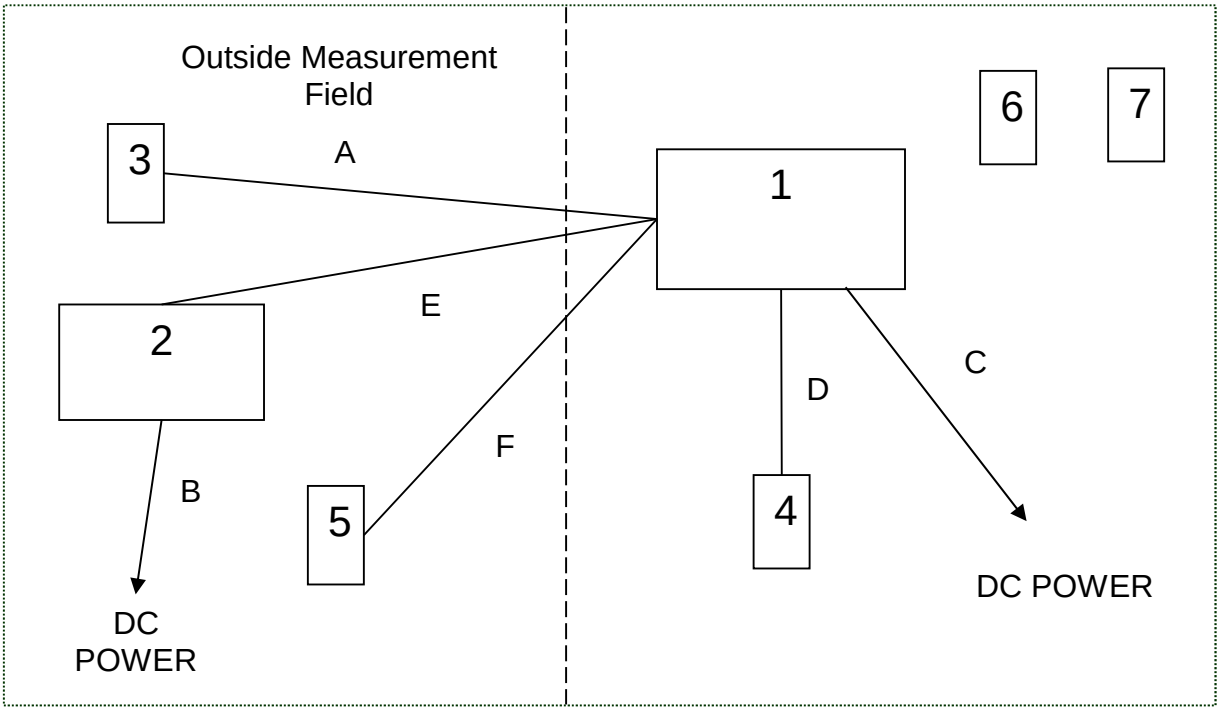


Figure 3.3-1: System Block Diagram

Table 3.3-1: EUT and Support Equipment Description

Item #	Type Device	Manufacturer	Model/Part #	Serial #
1	EUT	Johnson Outdoors	H9 G3N ENG	18080854-0015
2	Auxiliary Equipment	Johnson Outdoors	HELIX 7	180424220007
3	Precision GPS Module	Humminbird	AS*GPS	18081742-0006
4	Transducer	Johnson Outdoors	N/A	N/A
5	Speed sensor	Johnson Outdoors	N/A	N/A
6	Cellular Phone	N/A	N/A	N/A
7	Remote Control	Johnson Outdoors	RMT 1	N/A

Table 3.3-2: Cable Description

Cable #	Cable Type	Length	Shield	Termination
A	GPS	20’	No	1 - 3
B	DC leads	3’	No	2 – DC power
C	DC leads	4’	No	1 – DC power
D	Transducer cable	20’	No	1 - 4
E	Ethernet	20’	No	1 - 2
F	Speed sensor cable	20’	No	1 - 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

3.5 EUT Photographs

Figure 3.5-1: EUT Photo – Front

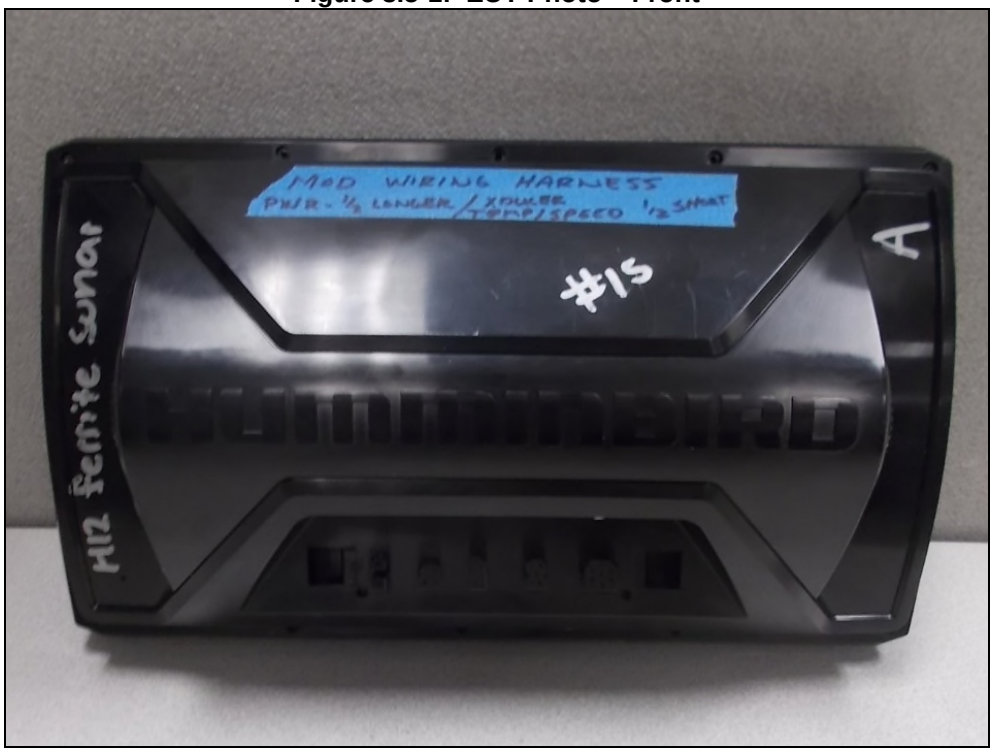


Figure 3.5-2: EUT Photo – Back

SECTION B: EMISSIONS – TEST INFORMATION AND RESULTS

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:

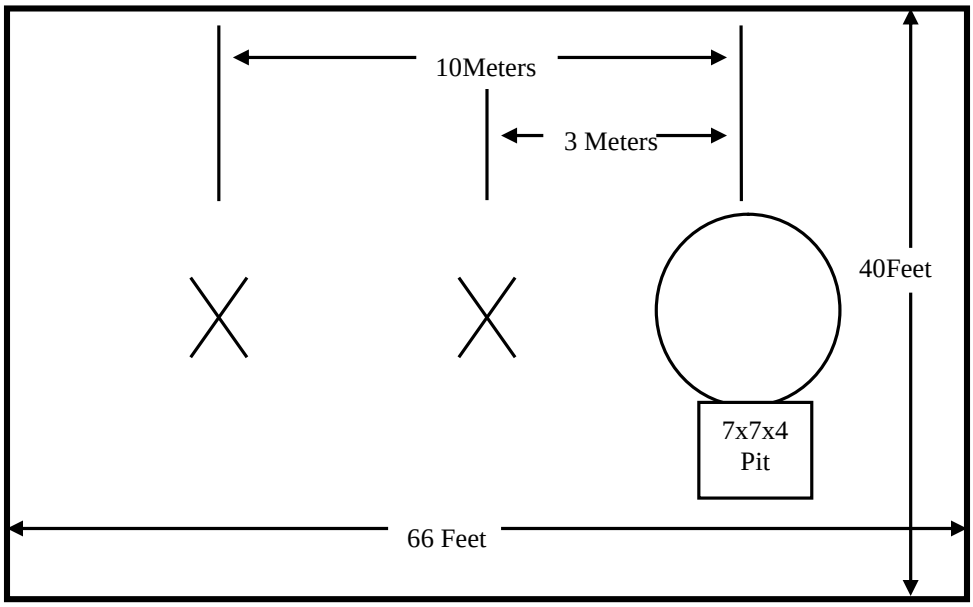


Figure 4.1.1.1-1: Open Area Test Site

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:

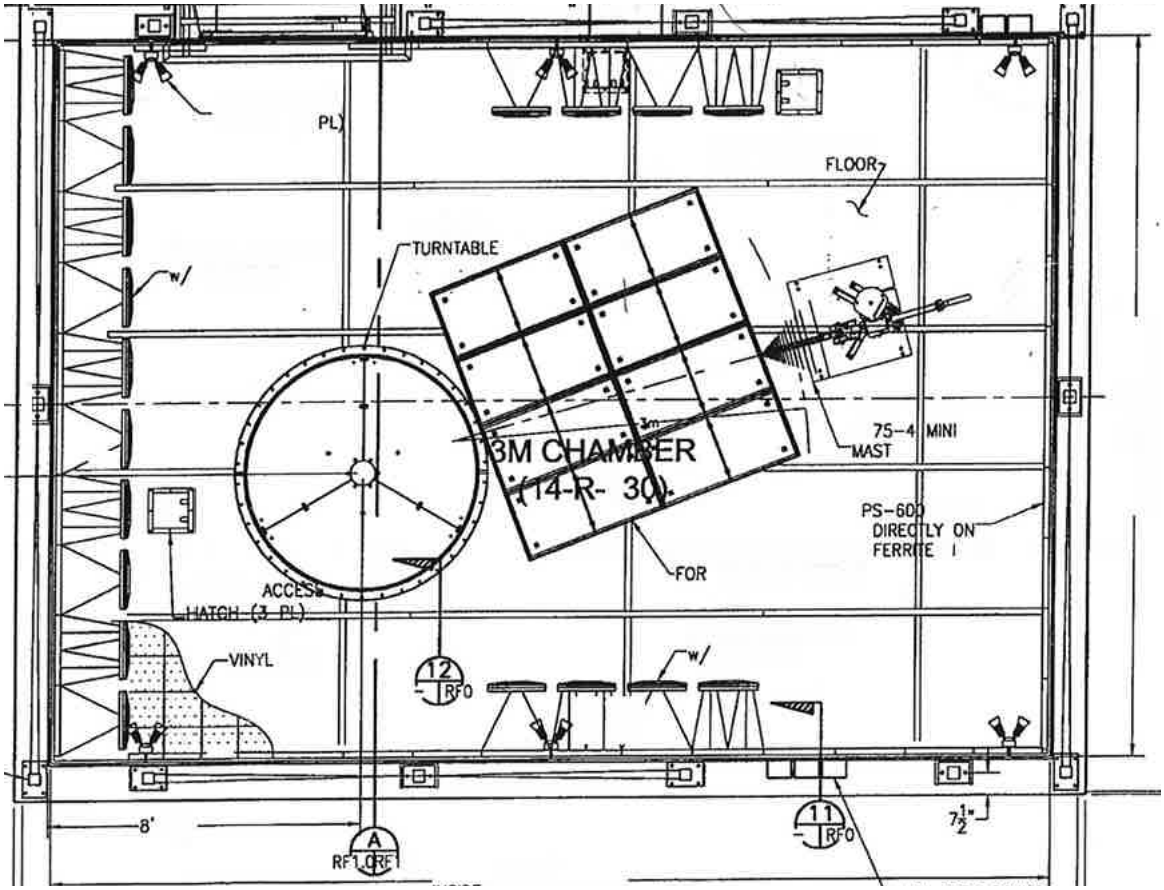


Figure 4.1.1.2-1: Semi-Anechoic Chamber Test Site

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:

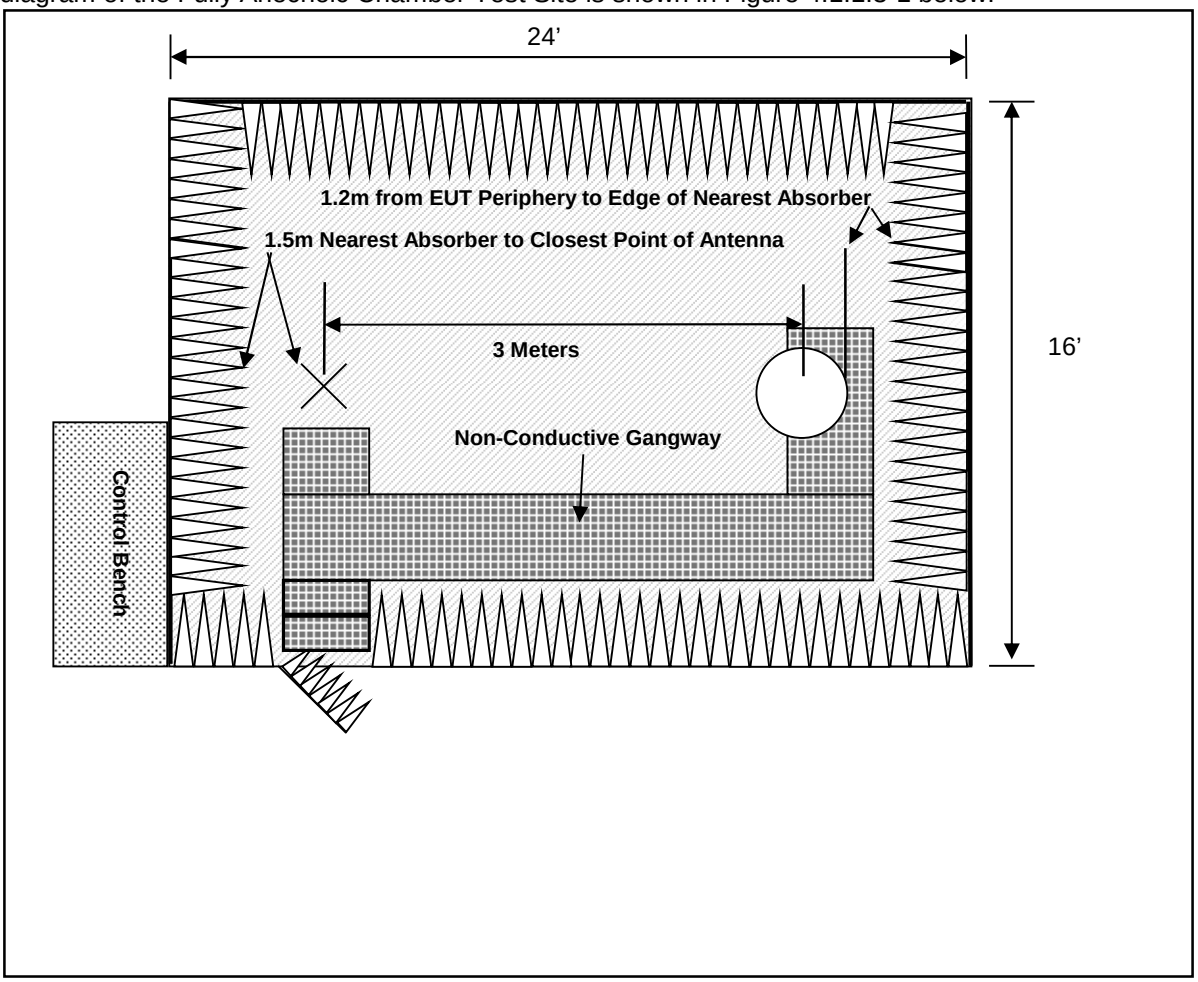


Figure 4.1.1.3-1: Fully Anechoic Chamber Test Site

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

Open Area Test Site

AssetID	Manufacturer	Model#	Equipment Type	Serial#	Calibration Performed Date	Calibration Due Date
90	Electro-metrics	LPA25	Antennas	1476	1/3/2018	1/3/2020
193	ACS	OATS Cable Set	Cable Set	0193	5/1/2018	5/1/2019
211	Eagle	C7RFM3NFNM	Filters	HLC-700	10/15/2017	10/15/2018
213	TEC	PA 102	Amplifiers	44927	7/19/2018	7/19/2019
819	Rohde & Schwarz	ESR26	EMI Test Receiver	101345	10/31/2017	10/31/2018
731	EMCO	3104	Antennas	2659	11/09/2016	11/09/2018

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 4.1.1.1. 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 150kHz to 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 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:

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

4.1.3.3 Test Criteria

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

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:**

4.1.4 Test Setup Photographs

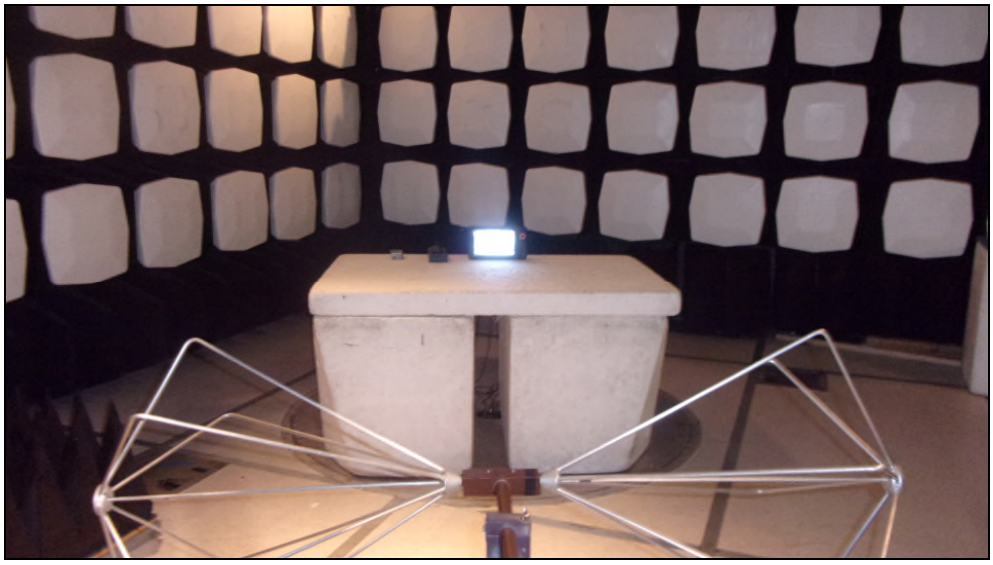


Figure 4.1.4-1: Radiated Emissions - Front View

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:	**October 5, 2018**	**Temperature (ºC)**	**22**
Technician:	**Tyler Leeson**	**Humidity (%)**	**37**
Equipment Class:	**Class B**	**Barometric Pressure (mBar)**	**1018**
Tested Modes:	**EUT on; auxillary unit, GPS puck, depth simulator and speedometer blade under floor**		
AC Input Power:	**N/A**		
DC Input Power:	**12 VDC**		

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
42.07	41.70	37.10	V	100	90	-13.24	---------	23.86	--------	30.0	---------	6.1
250	34.70	29.50	H	150	270	-9.90	---------	19.60	--------	37.0	---------	17.4
350	25.50	15.10	H	100	360	-7.10	---------	8.00	--------	37.0	---------	29.0
98.4675	50.10	45.30	V	100	264	-11.71	---------	33.59	--------	40.5	---------	6.9
550	40.80	36.90	V	100	360	-2.50	---------	34.40	--------	47.5	---------	13.1
777.95	24.30	14.90	H	100	360	0.88	---------	15.78	--------	47.5	---------	31.7

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

Notes:

98.4675 MHz, 550 MHz, and 777.95 MHz measured in SAC due to local ambient interference.

There were no significant emissions found 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 a 12' x 10' horizontal coupling plane(HCP) as well as a 12'x10' vertical coupling plane(VCP). The HGP is constructed of 4' x 10' sheets of particle board sandwiched by galvanized steel sheets. These panels are bonded using 11AWG 1/8" x 2" by 10' galvanized sheet steel secured to the panels via by screws. The VCP is constructed of three 4'x8' sheets of 11AWG solid aluminum.

The HCP and VCP are electrically bonded together using 1"x1" angled aluminum secured with screws.

The site is of sufficient size to test table top and floor standing equipment in accordance with section 6.1.4 of ANSI C63.4:2003 and 2009.

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

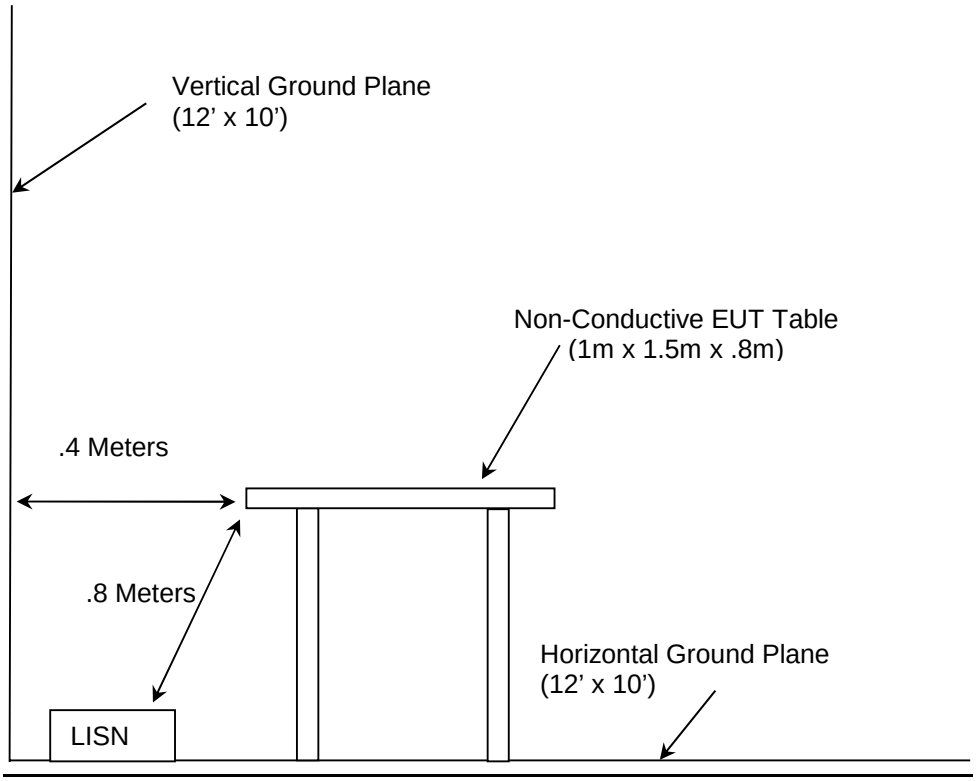


Figure 4.2.1-1: AC Mains Conducted EMI Site

4.2.2 Test Equipment

Table 4.2.2-1 Test Equipment – Conducted Emissions

AssetID	Manufacturer	Model#	Equipment Type	Serial#	Calibration Performed Date	Calibration Due Date
324	ACS	Belden	Cables	8214	4/5/2018	4/5/2019
144	Omega	RH411	Climate Monitoring Equipment	H0103373	9/1/2016	3/11/2019
3010	Rohde & Schwarz	ENV216	LISN	3010	7/11/2018	7/11/2019
813	PMM	9010	Receiver	697WW30606	2/12/2018	2/12/2019

Conducted Emissions Telecom

AssetID	Manufacturer	Model#	Equipment Type	Serial#	Calibration Performed Date	Calibration Due Date
168	Hewlett Packard	11947A	Attenuators	44829	1/22/2018	1/22/2019
324	ACS	Belden	Cables	8214	4/5/2018	4/5/2019
419	Teseq	ISN T800	LISN	25203	8/9/2017	2/09/20
144	Omega	RH411	Climate Monitoring Equipment	H0103373	9/1/2016	3/11/2019
561	Teseq	ISN ST08	Coupler	31286	7/11/2018	7/11/2019
813	PMM	9010	Receiver	697WW30606	2/12/2018	2/12/2019

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 = Corrected Reading – Applicable Limit

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

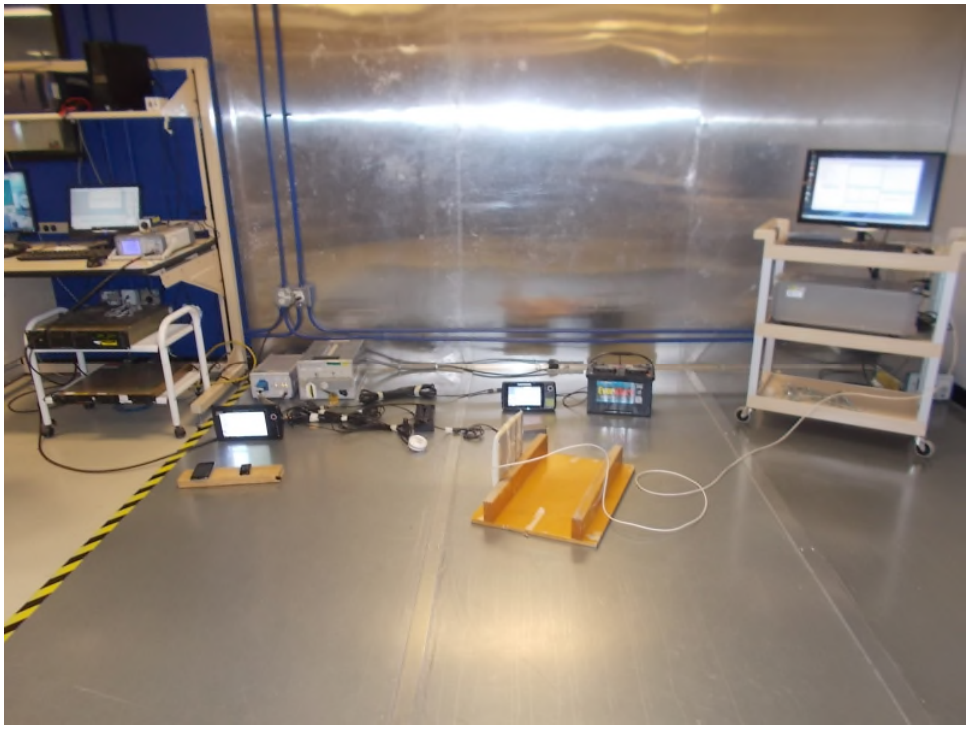


Figure 4.2.4-1: Conducted Emissions Test Setup – Front View

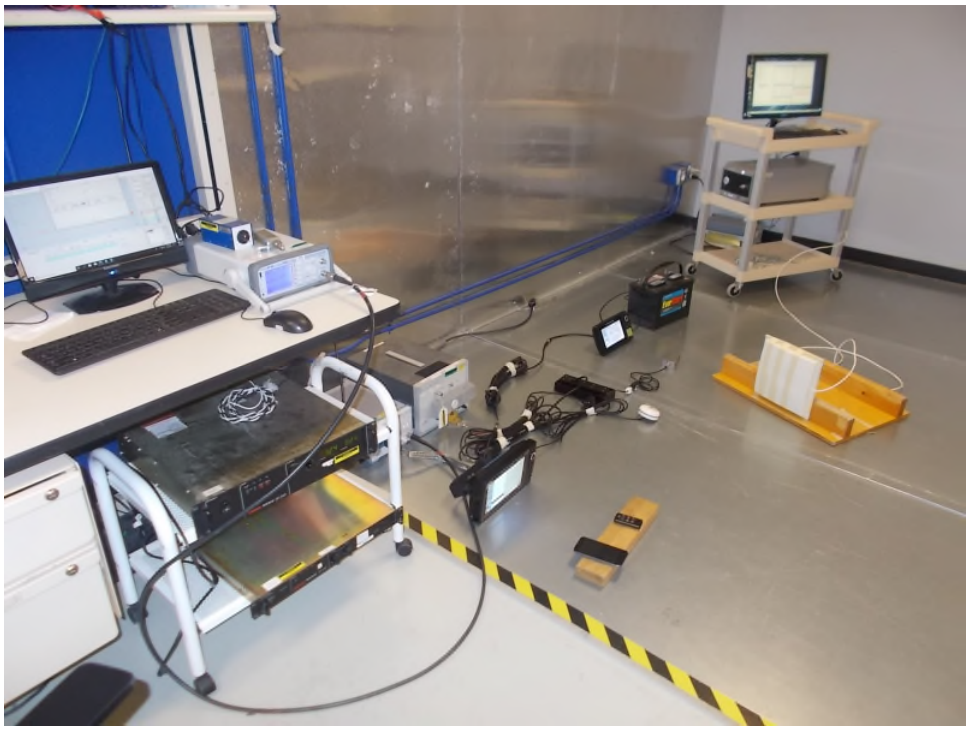


Figure 4.2.4-2: Conducted Emissions Test Setup – Side View

4.2.5 Test Data

Tabulated data is given in the Test Data Tables below.

Test Parameters:

Test Date:	**October 3, 2018**	**Temperature (ºC)**	**23**
Technician:	**Art Sumner**	**Humidity (%)**	**42**
Equipment Class:	**B**	**Barometric Pressure (mBar)**	**1012**
Tested Modes:	**Powered ON; GPS and Bluetooth active**		
AC Input Power:	**N/A**		
DC Input Power:	**12Vdc**		

Tested Leads:

☐ **AC Mains – Number of Lines:**
☒ **DC Mains – Number of Lines: 2**
☒ **Telecom Port – Quantity: 1**

Line 1

Frequency (MHz)	Corrected Reading		Limit		Margin		
	Quasi-Peak (dBuV)	Average (dBuV)	Quasi-Peak (dBuV)	Average (dBuV)	Quasi-Peak (dB)	Average (dB)	Correction (dB)
0.01	23.45	-----	96	-----	-72.55	-----	10.07
0.0102	23.43	-----	95.66	-----	-72.23	-----	10.06
0.0604	24.51	-----	65.45	-----	-40.94	-----	9.6
0.121	37.72	-----	53.65	-----	-15.93	-----	9.59
3.398	34.98	-----	50	-----	-15.02	-----	9.62
3.458	39.71	-----	50	-----	-10.29	-----	9.62
6.362	40.65	-----	50	-----	-9.35	-----	9.66
6.574	40.52	-----	50	-----	-9.48	-----	9.66
6.634	40.05	-----	50	-----	-9.95	-----	9.66
6.902	43.61	-----	50	-----	-6.39	-----	9.67
7.774	43.27	-----	50	-----	-6.73	-----	9.67
7.982	40.63	-----	50	-----	-9.37	-----	9.67
8.042	41.47	-----	50	-----	-8.53	-----	9.67
8.486	40.89	-----	50	-----	-9.11	-----	9.67

Notes:

Neutral

Frequency (MHz)	Corrected Reading		Limit		Margin		
	Quasi-Peak (dBuV)	Average (dBuV)	Quasi-Peak (dBuV)	Average (dBuV)	Quasi-Peak (dB)	Average (dB)	Correction (dB)
0.01	23.38	-----	96	-----	-72.62	-----	10
0.0102	23.36	-----	95.66	-----	-72.3	-----	9.99
0.0605	24.73	-----	65.42	-----	-40.69	-----	9.6
0.121	38.02	-----	53.65	-----	-15.63	-----	9.59
3.482	42.47	-----	50	-----	-7.53	-----	9.62
6.358	38.17	-----	50	-----	-11.83	-----	9.65
6.718	40.91	-----	50	-----	-9.09	-----	9.66
6.838	40.46	-----	50	-----	-9.54	-----	9.66
6.898	42.16	-----	50	-----	-7.84	-----	9.66
7.434	41.82	-----	50	-----	-8.18	-----	9.66
7.826	41.46	-----	50	-----	-8.54	-----	9.67
8.126	43.29	-----	50	-----	-6.71	-----	9.67
8.186	42.8	-----	50	-----	-7.2	-----	9.67
8.486	41.88	-----	50	-----	-8.12	-----	9.67

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:**

EUT is not powered by AC mains. HCE test is not applicable.

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:**

EUT is not powered by AC mains. VFF test is not applicable.

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#	Calibration Performed Date	Calibration Due Date
144	Omega	RH411	Climate Monitoring Equipment	H0103373	10/24/2018	10/24/2020
375	Fluke	Fluke 115	Meters	93771446	7/10/2018	7/10/2020
582	Kikusui	KES4021A	ESD Gun	SA003046	5/17/2018	5/17/2019

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

EN60945 requires performance criterion B to be met as described in section 1.4.4

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

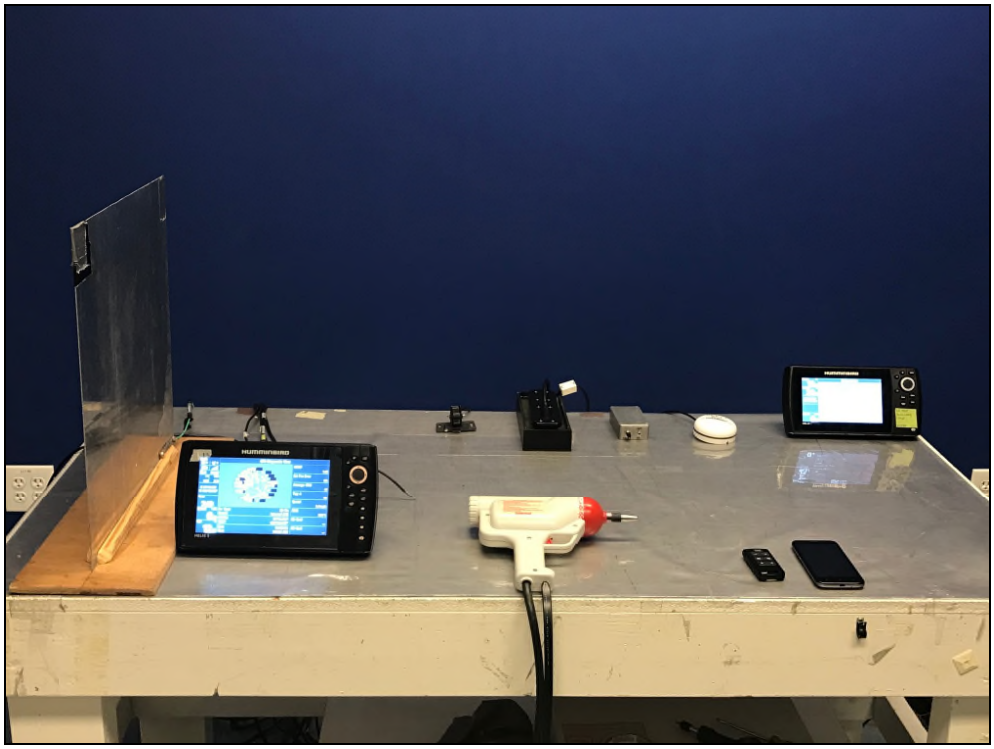
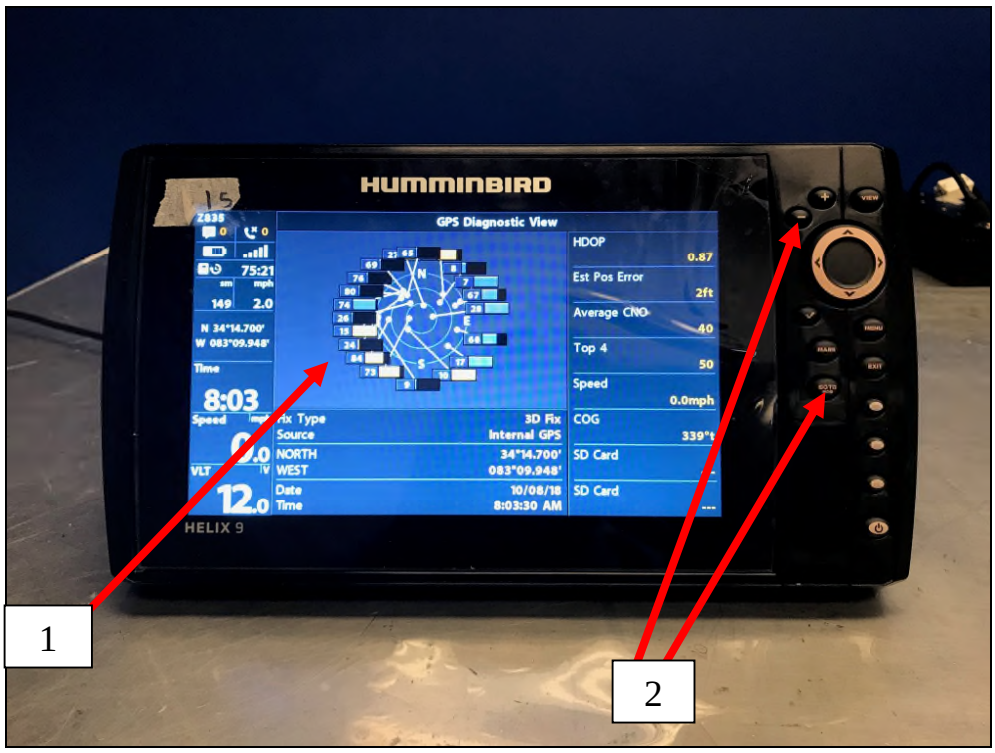
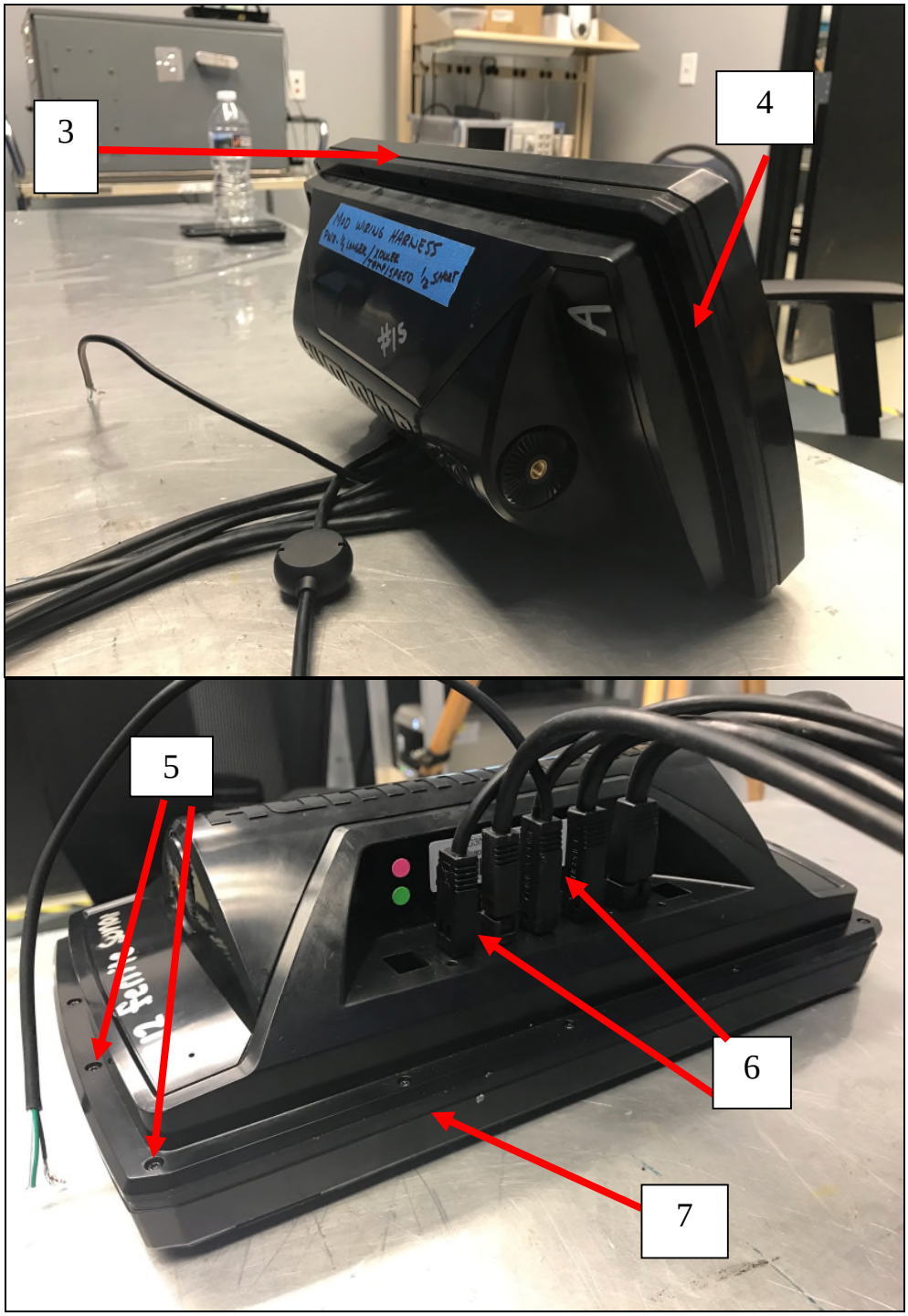


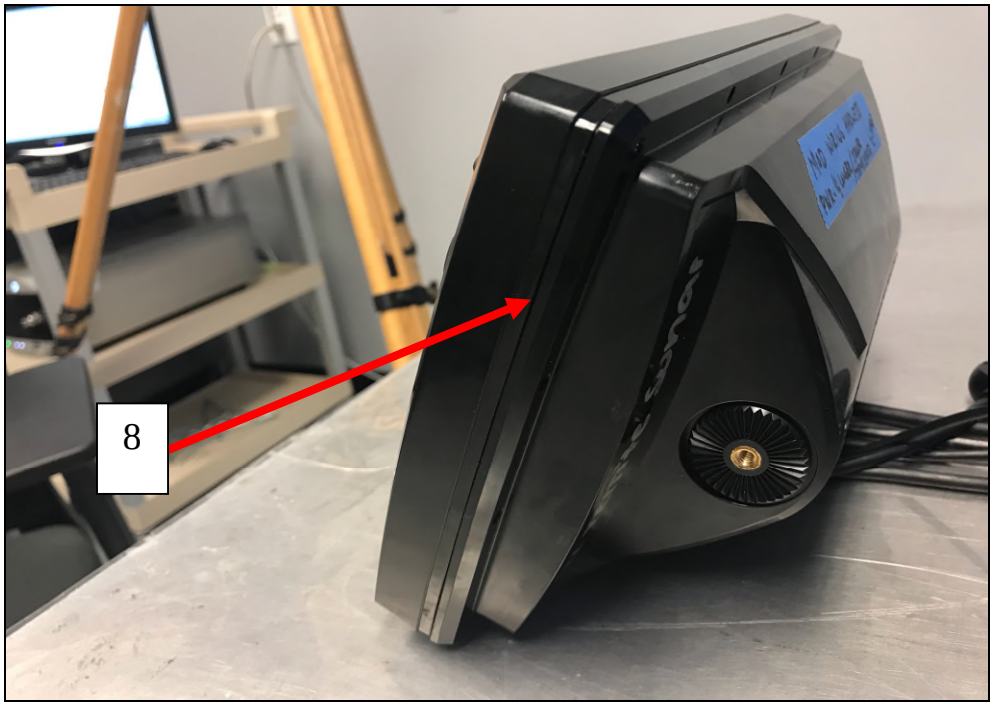
Figure 7.4-1: Test Setup Photograph

7.5 ESD Data Sheet

Test Point Photograph:




3
4
5
6
7



Test Point Selection:

TEST POINT#	DESCRIPTION	TYPE (C/A)	TEST POINT#	DESCRIPTION	TYPE (C/A)
1	Touchscreen	**Air**	5	Connecting Screws	**Contact**
2	Pushbuttons	**Air**	6	I/O Ports	**Air**
3	Top Seam	**Air**	7	Bottom Seam	**Air**
4	Right Seam	**Air**	8	Left Seam	**Air**

7.6 Test Data

Test Parameters:

Test Date:	**August 20, 2018**	**Temperature (ºC)**	**21.5**
Technician:	**Eugene Sello**	**Humidity (%)**	**57.6**
Equipment Class:	**N/A**	**Barometric Pressure (mBar)**	**982**
		☒ **Pre-test Verification Complete**	
Tested Modes:	**Powered On; GPS active; Bluetooth conected**		
AC Input Power:	**N/A**	**VCP Resistor Value Check:**	**950k (Ohms)**
DC Input Power:	**12VDC Battery**	**HCP Resistor Value Check:**	**955k (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	

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	Contact	Pass	
6	Air	Pass	
7	Air	Pass	
8	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#	Calibration Performed Date	Calibration Due Date
197	Amplifier Research	DC6080	Coupler	307006	NCR	NCR
354	ETS Lindgren	3142C	Antennas	00078838	NCR	NCR
370	IFI	CMX5002	Amplifier	L364-0407	NCR	NCR
144	Omega	RH411	Climate Monitoring Equipment	H0103373	9/1/2016	3/11/2019
684	Rohde & Schwarz	SML03	Signal Generators	103503	7/11/2018	7/11/2019
711	Hewlett Packard	8648B	Signal Generators	3623A01926	7/11/2018	7/11/2019
214	Holaday	HI-4433-GRE	Probes	00034096	4/12/2018	4/12/2019
836	ETS Lindgren	Chamber B EMI Cable Set	Cable Set	836	5/1/2018	5/1/2019
824	IFI	CMX5001	Amplifier	932-1095	NCR	NCR

High Frequency RFI

AssetID	Manufacturer	Model#	Equipment Type	Serial#	Calibration Performed Date	Calibration Due Date
329	A.H. Systems	SAS-571	Antennas	721	8/3/2017	8/3/2019
144	Omega	RH411	Climate Monitoring Equipment	H0103373	9/1/2016	3/11/2019
836	ETS Lindgren	Chamber B EMI Cable Set	Cable Set	836	5/1/2018	5/1/2019
684	Rohde & Schwarz	SML03	Signal Generators	103503	7/11/2018	7/11/2019
214	Holaday	HI-4433-GRE	Probes	00034096	4/12/2018	4/12/2019
1115	Varian	VZC6961G1	Amplifier	884	NCR	NCR
1116	Varian	VZM6991G5	Amplifier	1147	NCR	NCR
814	Ophir	5293FE	Amplifier	1046	NCR	NCR

Semi-Anechoic Chamber - RFI

AssetID	Manufacturer	Model#	Equipment Type	Serial#	Calibration Performed Date	Calibration Due Date
354	ETS Lindgren	3142C	Antennas	00078838	NCR	NCR
370	IFI	CMX5002	Amplifier	L364-0407	NCR	NCR
144	Omega	RH411	Climate Monitoring Equipment	H0103373	9/1/2016	3/11/2019
619	Teledyne Storm Microwave	90-195-456	Cables	13-10-601	NCR	NCR
620	Teledyne Storm Microwave	90-195-456	Cables	13-10-602	NCR	NCR
624	Advantest	R3261C	Spectrum Analyzers	31720426	NCR	NCR
214	Holaday	HI-4433-GRE	Probes	00034096	4/12/2018	4/12/2019

NCR = No Calibration Required

8.3 Test Methodology

IEC 61000-4-3 - 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

EN60945 requires criterion A to be met as described in section 1.4.4.

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

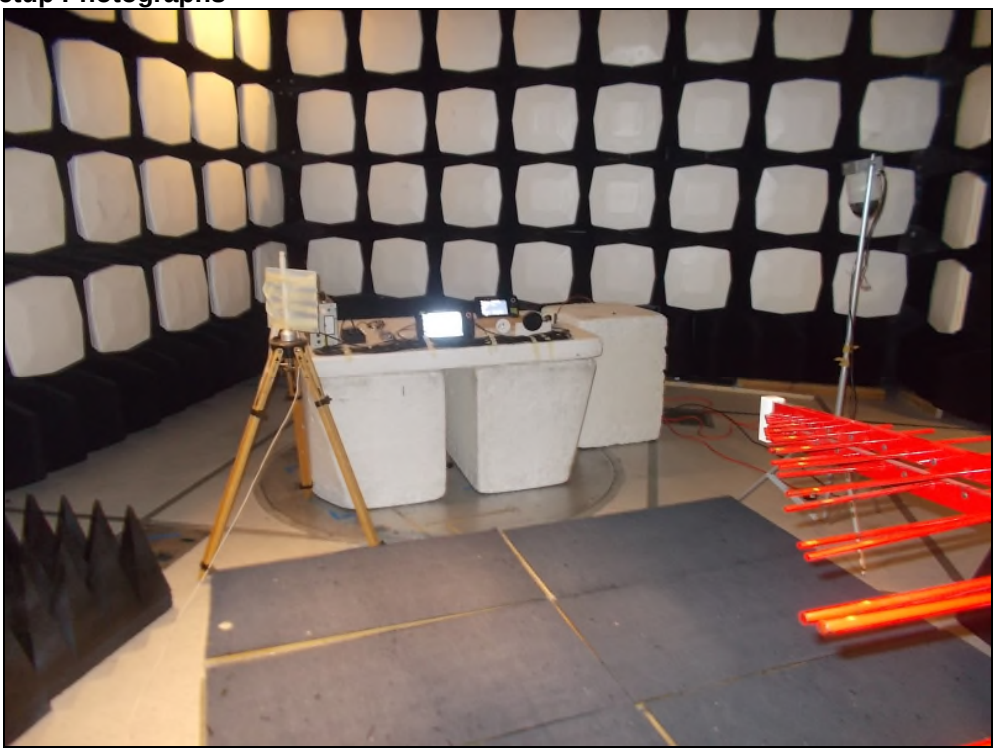


Figure 8.4-1: Test Setup Photograph

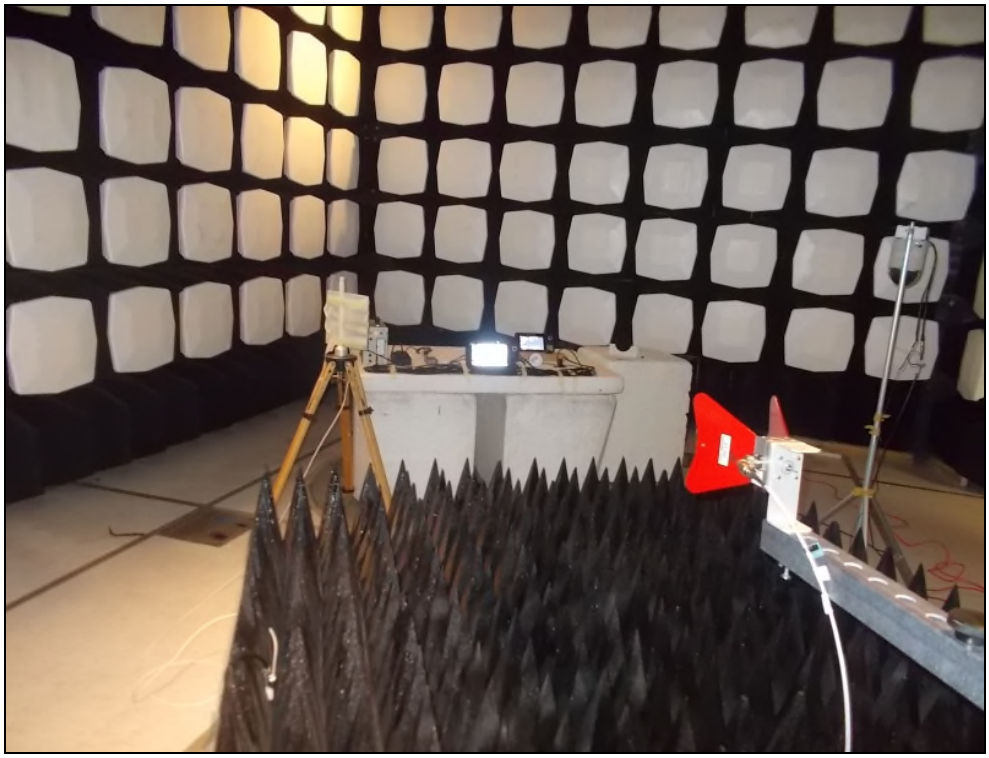


Figure 8.4-2: Test Setup Photograph

8.5 Test Results

Test Parameters:

Test Date:	**October 4, 2018**	**Temperature (ºC)**	**24**
Technician:	**Art Sumner**	**Humidity (%)**	**47**
Equipment Class:	**N/A**	**Barometric Pressure (mBar)**	**1008**
Tested Modes:	**Powered On; GPS active; Bluetooth conected**		
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	☒ 80-2000MHz@400Hz AM	☒ 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:

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#	Calibration Performed Date	Calibration Due Date
62	Haefely Trench	EFT Clamp	Immunity Equipment	N/A	3/13/2018	3/13/2019
494	Omega	iBTHX-W	Climate Monitoring Equipment	9460211	10/24/2018	10/24/2020
474	Keytek	EMC PRO	General Lab Equipment	9808246	3/13/2018	3/13/2019

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

EN60945 requires criterion B to be met as described in section 1.4.4.

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

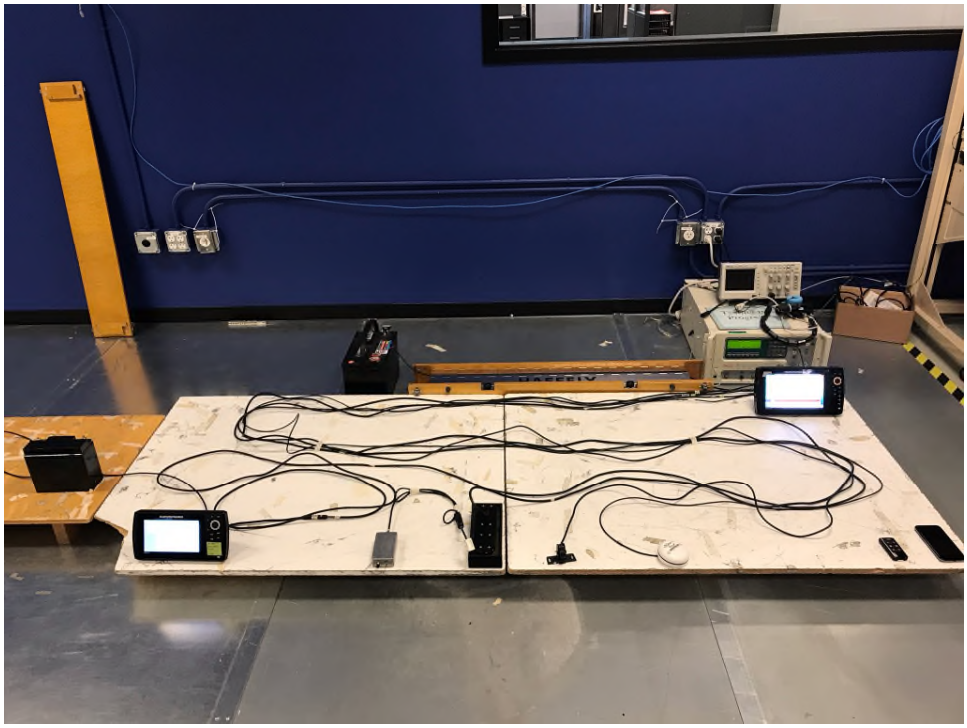


Figure 9.4-1: Test Setup Photograph

9.5 Test Results

Test Parameters:

Test Date:	**October 17, 2018**	**Temperature (ºC)**	**21**
Technician:	**Nica Fabian**	**Humidity (%)**	**58**
Equipment Class:	**N/A**	**Barometric Pressure (mBar)**	**1018**
Tested Modes:	**EUT on; GPS simulator connected, phone connected via bluetooth; Wireless remote connected; Sonar Transducer on**		
AC Input Power:	**N/A**	☒ **Pre-test Verification Complete**	
DC Input Power:	**12VDC**		

DC 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 input	Pass	
Ethernet	Pass	
Speedometer	Pass	
SONAR Transducer	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:

EUT was powered by 12Vdc and does not connect to AC public mains. Surge testing was not required.

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
Test Equipment List – Conducted Immunity

AssetID	Manufacturer	Model#	Equipment Type	Serial#	Calibration Performed Date	Calibration Due Date
5	Chase	CSP-8441	Probes	19	6/19/2018	6/19/2020
93	Chase	8101	Clamp	65	5/24/2018	5/24/2019
96	Chase	1000-M3-25	CDN	9806	5/1/2018	5/1/2019
364	Amplifier Research	DC2600A	Coupler	0322466	NCR	NCR
370	IFI	CMX5002	Amplifier	L364-0407	NCR	NCR
418	Teseq	ISN-S501	LISN	24543	5/1/2018	5/1/2019
425	ACS	EMC Cable Set	Cable Set	425	NCR	NCR
457	Com Power	CDN-M2-25	Coupler	511023	7/11/2018	7/11/2019
471	Bird Technologies Group	150-A-FFN-06	Attenuators	0914	NCR	NCR
144	Omega	RH411	Climate Monitoring Equipment	H0103373	9/1/2016	3/11/2019
634	Fischer Custom Communications Inc.	FCC-801-M3-16	CDN	9730	5/22/2018	5/22/2019
711	Hewlett Packard	8648B	Signal Generators	3623A01926	7/11/2018	7/11/2019
684	Rohde & Schwarz	SML03	Signal Generators	103503	7/11/2018	7/11/2019

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 1.5×10^{-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

EN60945 requires criterion A to be met as described in section 1.4.4.

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

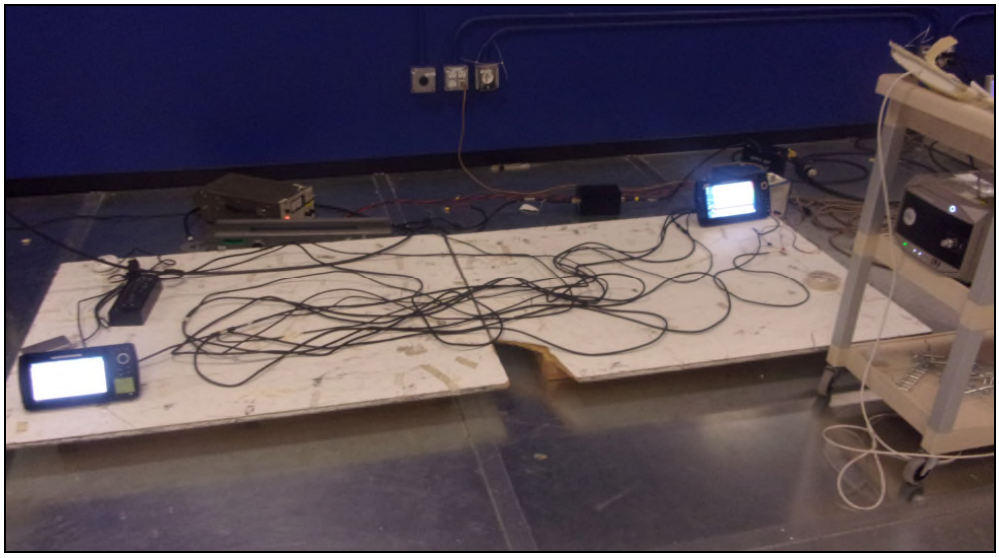


Figure 11.4-1: Test Setup Photograph

11.5 Test Results

Test Parameters:

Test Date:	**October 26, 2018**	**Temperature (ºC)**	**23**
Technician:	**Tyler Leeson**	**Humidity (%)**	**44**
Equipment Class:	**N/A**	**Barometric Pressure (mBar)**	**987**
Tested Modes:	**Powered ON; displaying depth, speed info, GPS and BT active; connected to AUX unit**		
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@400Hz AM
☐ Enter Other Band Here

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

Notes:
The following spot frequencies were tested at 10Vrms: 2MHz, 3MHz, 6.2MHz, 8.2MHz, 12.6MHz, 16.5MHz, 18.8MHz, 22MHz, and 25MHz

Signal Line Test Data:

Check All That Apply to This Data

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

Freq. Band:
☒ .150-80MHz@400Hz AM
☐ Enter Other Band Here

Signal Line	Result	Observation (Describe any detectable event)
GPS input	Pass	
Ethernet	Pass	
Speedometer	Pass	
SONAR Transducer	Pass	

Notes:
The following spot frequencies were tested at 10Vrms: 2MHz, 3MHz, 6.2MHz, 8.2MHz, 12.6MHz, 16.5MHz, 18.8MHz, 22MHz, and 25MHz

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:

EUT does not employ any magnetically sensitive components. PFMF test is not applicable

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:

EUT is powered by 12Vdc battery. VDI testing is not applicable.

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 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 – ANAB Accreditation Certificate

CERTIFICATE OF ACCREDITATION

ANSI-ASQ National Accreditation Board
500 Montgomery Street, Suite 625, Alexandria, VA 22314, 877-344-3044

This is to certify that

TÜV SÜD America, Inc.
5015 B. U. Bowman Drive
Buford, GA 30518

has been assessed by ANAB
and meets the requirements of international standard

ISO/IEC 17025:2005

while demonstrating technical competence in the field of

TESTING

Refer to the accompanying Scope of Accreditation for information regarding the types of tests to which this accreditation applies.

AT-2021
Certificate Number

ANAB Approval

Certificate Valid: 03/14/2018 - 12/17/2018
Version No. 013 Issued: 03/14/2018

This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2005. This accreditation demonstrates technical competence for a defined scope and the operation of a laboratory quality management system (refer to joint ISO-ILAC-IAF Communiqué dated April 2017).