EMC Technical Report

Prepared For: Johnson Outdoors Marine Electronics, Inc.

Model Covered: SOLIX 12 SI (410400-1)
Model Variants: SOLIX 12 (410390-1)

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

Product Standard: EN 301 489-3 V1.6.1 and EN 301 489-17 V2.2.1 with respect to EN 301 489-1 V1.9.2

ACS Report: 16-0526.C09.3A
Report Revision: A
Report Issue Date: January 20, 2017

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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 51 pages

REVISION HISTORY
Report Number: 16-0526.C09.3A
Manufacturer: Johnson Outdoors Marine Electronics, Inc.
Model: SOLIX 12 SI (410400-1)

DATE	OLD REVISION	NEW REVISION	REASON	PAGES AFFECTED	APPROVED BY
January 20, 2017	---	A	Initial Release	All	Forrest Duncan

Project Information Sheet

ACS Project: 16-0526.C09.3A

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: Chris Bennett

Phone: 334-687-6613 ext 1290
Fax:
Email: cbennett@johnsonoutdoors.com

Sample Information

Model: SOLIX 12 SI (410400-1)
Model Variant(s): SOLIX 12 (410390-1)
Environment of Use: Residential
Sample Receive Date: December 7, 2016
Sample Receive Condition: Good
Test Mode Description: Powered on; GPS and BT active; Monitoring depth
Unacceptable Degradation (Provided by Mfg.): The Depth reading should stay with +/- 2ft. The manufacturer declares an exclusion band for the SONAR and GPS frequencies of +/-5%. The sonar frequency is designed to work at 200kHz during normal operation.
Highest Data Rate: 1GHz
Source: Main processor

Product Description

The Humminbird SOLIX 12 SI is a fishfinder/GPS product with Side/Down imaging sonar capability to be used in the marine environment. It is comprised of a keypad, LCD display, Internal GPS, Ethernet, and capable of supporting external GPS, Ethernet, and both external NMEA 0183 and NMEA2K devices.

The SOLIX 12 is identical to the SOLIX 12 SI with the exception of the SW load that limits sonar to traditional 2D only.

Test Information

Test Start Date: December 7, 2016
Test End Date: December 18, 2016
Emissions Pre-scan Site: SAC
Final Emissions Site: SAC
EMI Freq. Band: 150kHz - 6GHz
RFI Site: FAC
Radiated Emissions Equipment Class: Class B
Harmonic Current EMI Class: N/A

Test Methods Applied

(Check all that apply)

- ☒ CISPR 16-2-1 Ed. 1.1 2005
- ☒ CISPR 16-2-3 1st Ed. 2003
- ☒ IEC 61000-4-2 Ed. 2.0
- ☒ IEC 61000-4-3 Ed. 3.2
- ☒ 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 EN 301 489-3 V1.6.1 and EN 301 489-17 V2.2.1 with respect to EN 301 489-1 V1.9.2 and details the results of testing performed on December 7, 2016 through December 18, 2016 on the model SOLIX 12 SI (410400-1) manufactured by Johnson Outdoors Marine Electronics, Inc..

1.2 Purpose

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

1.3 Results Summary

Product Standard or Test Method Applied	Description	Result
	Product Standards	
EN 301 489-1 V1.9.2	Electromagnetic compatibility and Radio spectrum Matters (ERM); ElectroMagnetic Compatibility (EMC) standard for radio equipment and services; Part 1: Common technical requirements	Pass
EN 301 489-3 V1.6.1	Electromagnetic compatibility and Radio spectrum Matters (ERM); ElectroMagnetic Compatibility (EMC) standard for radio equipment and services; Part 3: Specific conditions for Short-Range Devices (SRD) operating on frequencies between 9 kHz and 246 GHz	Pass
EN 301 489-17 V2.2.1	Electromagnetic compatibility and Radio spectrum Matters (ERM); ElectroMagnetic Compatibility (EMC) standard for radio equipment and services; Part 17: Specific conditions for Broadband Data Transmission Systems	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 EN 301 489-3 and EN 301 489-17	
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	Pass
IEC 61000-4-5 2nd Ed.	Electromagnetic compatibility (EMC) - Part 4-5: Testing and measurement techniques - Surge immunity test	N/A
IEC 61000-4-6 3rd Ed.	Electromagnetic compatibility (EMC) - Part 4-6: Testing and measurement techniques - Immunity to conducted disturbances, induced by radio-frequency fields	Pass
IEC 61000-4-8 2nd Ed.	Electromagnetic compatibility (EMC) - Part 4-8: Testing and measurement techniques - Power frequency magnetic field immunity test	N/A
IEC 61000-4-11 2nd Ed.	Electromagnetic compatibility (EMC) - Part 4-11: Testing and measurement techniques - Voltage dips, short interruptions and voltage variations immunity tests	N/A

N/A = 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 SOLIX 12 SI (410400-1) the limits which apply are shown in Table 1.4.1-1 below:

Table 1.4.1-1 Emissions Limits Class B

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

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

1.4.2 Immunity Performance Criteria

EN 301 489-3

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

Table 1.4.2-1: Equipment Type Description

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

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

Table 1.4.2-2: SRD Classification

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

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

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

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

Table 1.4.2-3: Performance Table

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

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

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

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

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

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

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

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

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

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

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

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

EN 301 489-17

Each immunity test requires 1 of 3 performance criteria to be met. The performance criteria is given as:

- performance criteria A for immunity tests with phenomena of a continuous nature;
- performance criteria B for immunity tests with phenomena of a transient nature;
- performance criteria C for immunity tests with power interruptions exceeding a certain time.

The equipment shall meet the minimum performance criteria as defined in table 1.4.2-4 below:

Table: 1.4.2-4

Criteria	During test	After test
A	Shall operate as intended May show degradation of performance (see note 1) Shall be no loss of function Shall be no unintentional transmissions	Shall operate as intended Shall be no degradation of performance (see note 2) Shall be no loss of function Shall be no loss of stored data or user programmable functions
B	May show loss of function (one or more) May show degradation of performance (see note 1) No unintentional transmissions	Functions shall be self-recoverable Shall operate as intended after recovering Shall be no degradation of performance (see note 2) Shall be no loss of stored data or user programmable functions
C	May be loss of function (one or more)	Functions shall be recoverable by the operator Shall operate as intended after recovering Shall be no degradation of performance (see note 2)
NOTE 1:	Degradation of performance during the test is understood as a degradation to a level not below a minimum performance level specified by the manufacturer for the use of the apparatus as intended. In some cases the specified minimum performance level may be replaced by a permissible degradation of performance. If the minimum performance level or the permissible performance degradation is not specified by the manufacturer then either of these may be derived from the product description and documentation (including leaflets and advertising) and what the user may reasonably expect from the apparatus if used as intended.	
NOTE 2:	No degradation of performance after the test is understood as no degradation below a minimum performance level specified by the manufacturer for the use of the apparatus as intended. In some cases the specified minimum performance level may be replaced by a permissible degradation of performance. After the test no change of actual operating data or user retrievable data is allowed. If the minimum performance level or the permissible performance degradation is not specified by the manufacturer then either of these may be derived from the product description and documentation (including leaflets and advertising) and what the user may reasonably expect from the apparatus if used as intended.	

Performance criteria for Continuous phenomena applied to Transmitters (CT)
The performance criteria A shall apply. Tests shall be repeated with the EUT in standby mode (if applicable) to ensure that unintentional transmission does not occur. In systems using acknowledgement signals, it is recognized that an ACKnowledgement (ACK) or Not ACKnowledgement (NACK) transmission may occur, and steps should be taken to ensure that any transmission resulting from the application of the test is correctly interpreted.

Performance criteria for Transient phenomena applied to Transmitters (TT)
The performance criteria B shall apply, except for voltage dips of 100 ms and voltage interruptions of 5000ms duration, for which performance criteria C shall apply. Tests shall be repeated with the EUT in standby mode (if applicable) to ensure that unintentional transmission does not occur. In systems using acknowledgement signals, it is recognized that an acknowledgement (ACK) or not-acknowledgement (NACK) transmission may occur, and steps should be taken to ensure that any transmission resulting from the application of the test is correctly interpreted.

Performance criteria for Continuous phenomena applied to Receivers (CR)
The performance criteria A shall apply. Where the EUT is a transceiver, under no circumstances, shall the transmitter operate unintentionally during the test. In systems using acknowledgement signals, it is recognized that an ACK or NACK transmission may occur, and steps should be taken to ensure that any transmission resulting from the application of the test is correctly interpreted.

Performance criteria for Transient phenomena applied to Receivers (TR)
The performance criteria B shall apply, except for voltage dips of 100 ms and voltage interruptions of 5000ms duration for which performance criteria C shall apply. Where the EUT is a transceiver, under no circumstances, shall the transmitter operate unintentionally during the test. In systems using acknowledgement signals, it is recognized that an ACK or NACK transmission may occur, and steps should be taken to ensure that any transmission resulting from the application of the test is correctly interpreted.

2.0 Test Facilities & Environment

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

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

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

2.2 Laboratory Accreditations/Recognitions/Certifications
ACS is accredited to ISO/IEC 17025 by the 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

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

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

3.0 Equipment Under Test (EUT)

3.1 Manufacturer
Johnson Outdoors Marine Electronics, Inc.
678 Humminbird Lane
Eufaula, AL 36027
Chris Bennett
334-687-6613 ext 1290
cbennett@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

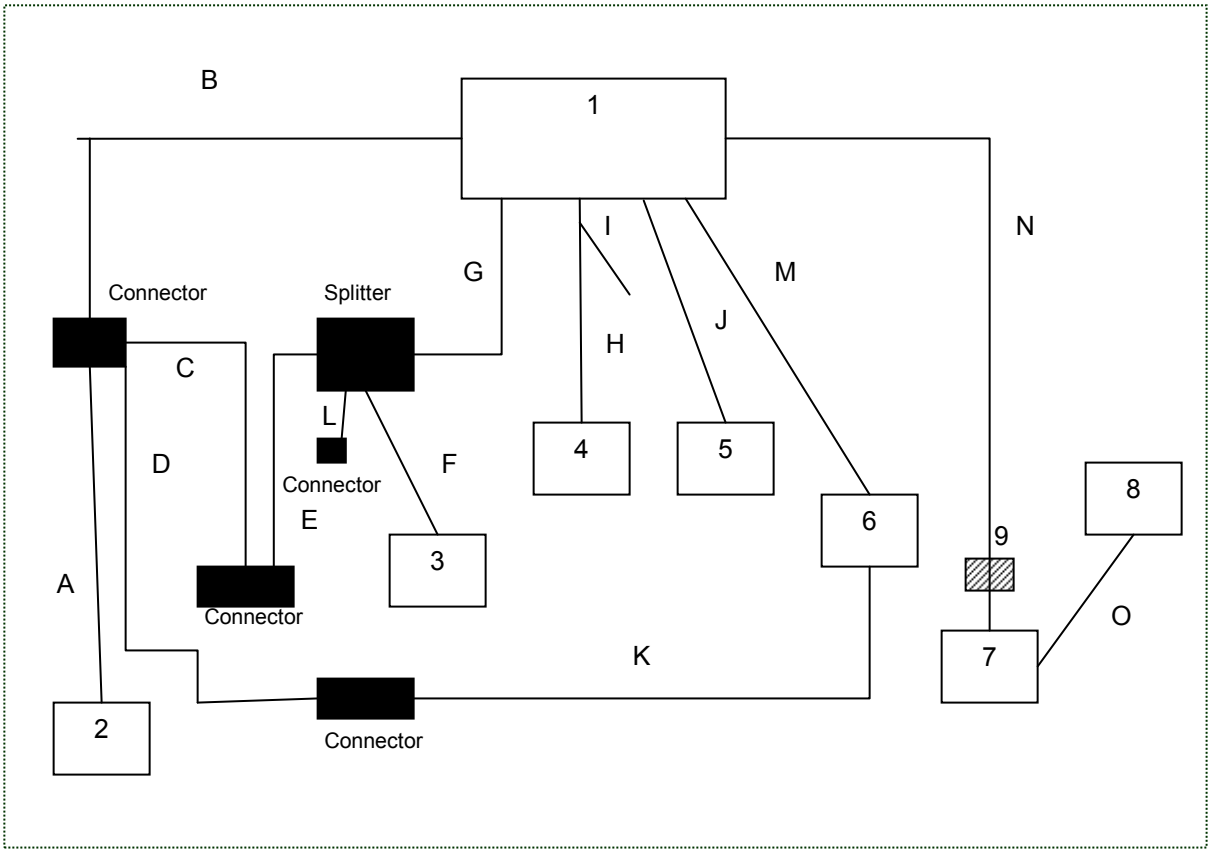


Figure 3.3-1: System Block Diagram

Table 3.3-1: EUT and Support Equipment Description

Item #	Type Device	Manufacturer	Model/Part #	Serial #
1	EUT	Johnson Outdoors	SOLIX 12 SI	X4-7
2	Battery	N/A	N/A	N/A
3	Antenna	Maretron	N/A	Acs#7
4	GPS Antenna	Johnson Outdoors	AS GPS HS	12071842-0039
5	PIS System	Techsonic Industries	G7X AIS	46090073
6	Ancillary Display	Johnson Outdoors	SOLIX 15	X4-1
7	Transducer	Johnson Outdoors	N/A	Acs#6
8	Depth Simulator	Johnson Outdoors	N/A	Acs#5
9	Ferrite bead	Fair-Rite	0475178281	N/A

Table 3.3-2: Cable Description

Cable #	Cable Type	Length	Shield	Termination
A	DC Leads	130cm	No	2 - connector
B	DC Leads	180cm	No	1 - connector
C	DC Leads	160cm	No	Connector - connector
D	DC Leads	160cm	No	Connector - connector
E	DC Leads	700cm	No	Splitter - connector
F	Antenna coax cable	60cm	No	3 - splitter
G	DC Leads	300cm	No	1 - splitter
H	Antenna Coax cable	630cm	No	1 – 4
I	DC leads	60cm	No	1 – GND
K	DC Leads	100cm	No	6 – connector
L	DC Leads	160	No	Connector - splitter
M	Signal cable	900cm	No	1 – 6
N	Transducer cable	620cm	No	1 – 7
O	Coax cable	55ccm	No	7 – 8

3.4 Observations

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

Table 3.4-1: Observations

Observation No.	Description

SECTION B: EMISSIONS – TEST INFORMATION AND RESULTS

4.0 Radiated and Conducted Emissions

4.1 Radiated Emissions

4.1.1 Test Site Description

4.1.1.1 Open Area Test Site

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

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

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

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

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

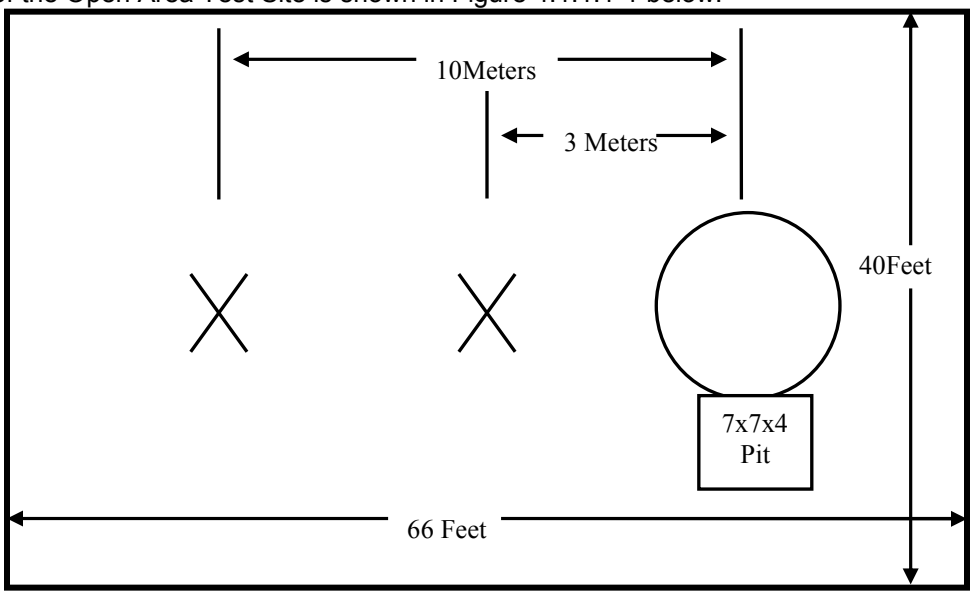


Figure 4.1.1.1-1: Open Area Test Site

4.1.1.2 Semi-Anechoic Chamber

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

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

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

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

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

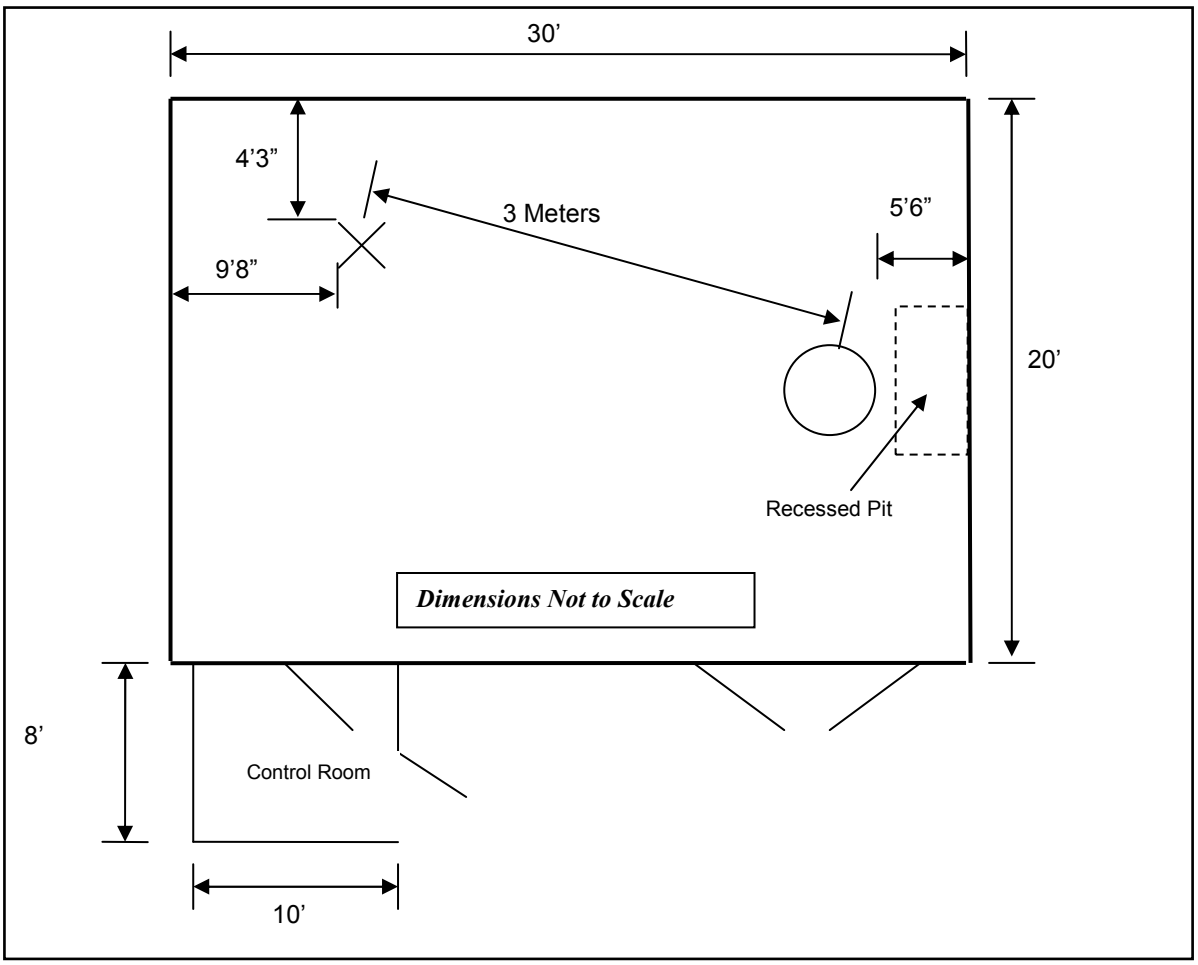


Figure 4.1.1.2-1: Semi-Anechoic Chamber Test Site

4.1.1.3 Fully Anechoic Chamber

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

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

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

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

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

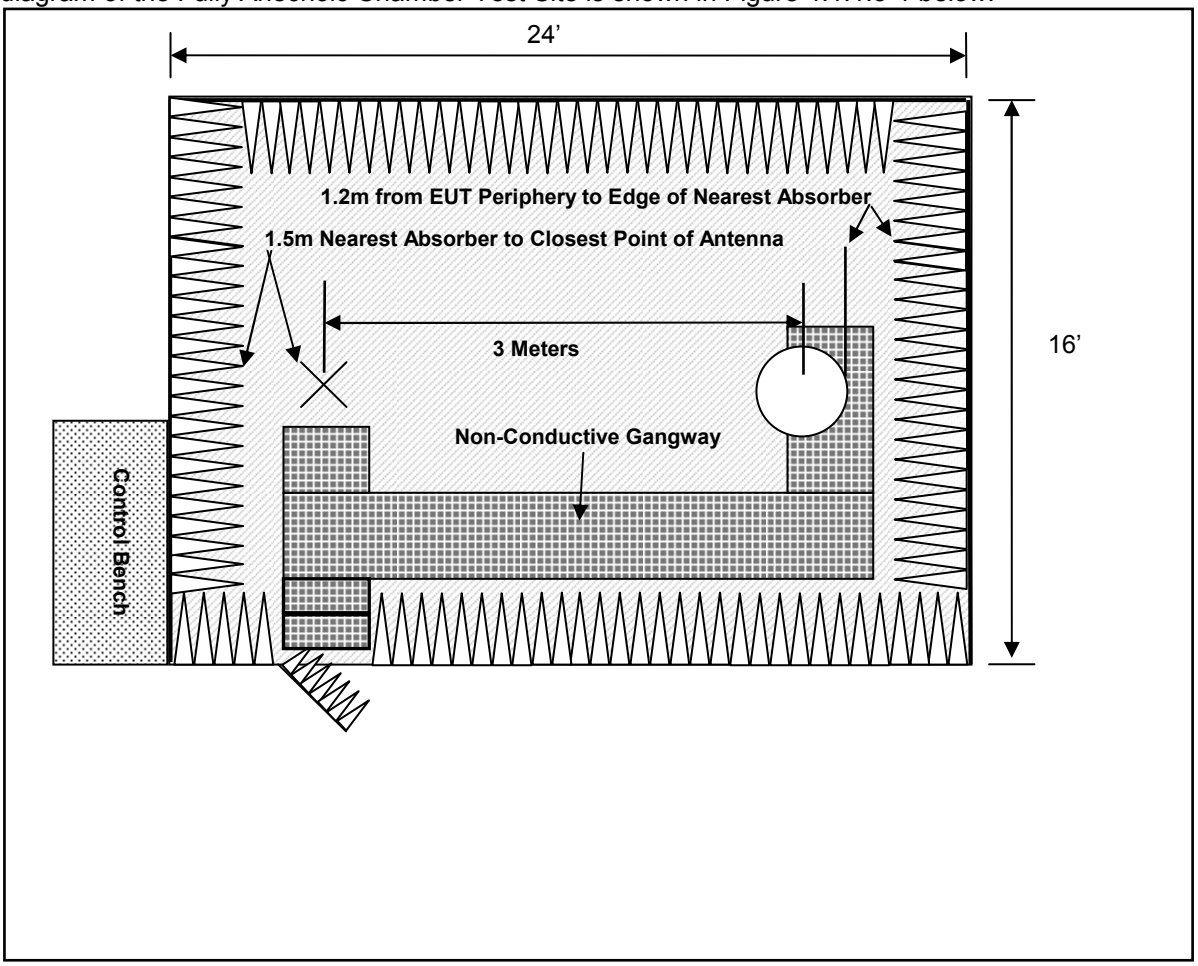


Figure 4.1.1.3-1: Fully Anechoic Chamber Test Site

4.1.2 Test Equipment

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

Table 4.1.2-1 Test Equipment – Radiated Emissions

Semi-Anechoic Chamber

AssetID	Manufacturer	Model#	Equipment Type	Serial#	Calibration Performed Date	Calibration Due Date
40	EMCO	3104	Antennas	3211	6/8/2016	6/8/2018
73	Agilent	8447D	Amplifiers	2727A05624	7/21/2016	7/21/2017
167	ACS	Chamber EMI Cable Set	Cable Set	167	9/30/2016	9/30/2017
412	Electro Metrics	LPA-25	Antennas	1241	8/8/2016	8/8/2018
494	Omega	iBTHX-W	Climate Monitoring Equipment	9460211	8/1/2016	8/1/2018
RE619	Rohde & Schwarz	ESU26	Spectrum Analyzers	100190	11/5/2014	11/5/2017

Semi-Anechoic Chamber High Frequency

AssetID	Manufacturer	Model#	Equipment Type	Serial#	Calibration Performed Date	Calibration Due Date
30	Spectrum Technologies	DRH-0118	Antennas	970102	4/30/2015	4/30/2017
338	Hewlett Packard	8449B	Amplifiers	3008A01111	8/21/2015	8/21/2017
422	Florida RF	SMS-200AW-72.0-SMR	Cables	0805	10/27/2016	10/27/2017
494	Omega	iBTHX-W	Climate Monitoring Equipment	9460211	8/1/2016	8/1/2018
616	Florida RF Cables	SMRE-200W-12.0-SMRE	Cables	N/A	9/2/2016	9/2/2017
676	Florida RF Labs	SMS-290AW-480.0-SMS	Cables	MFR2Y194	11/4/2016	11/4/2017
RE619	Rohde & Schwarz	ESU26	Spectrum Analyzers	1302.6005K26 Ser. 100190	11/5/2014	11/5/2017

Fully Anechoic Chamber

AssetID	Manufacturer	Model#	Equipment Type	Serial#	Calibration Performed Date	Calibration Due Date
321	Hewlett Packard	HPC 8447D	Amplifiers	1937A02809	7/21/2016	7/21/2017
326	ACS	EMI Cable Set-FAC	Cables	326	7/21/2016	7/21/2017
354	ETS Lindgren	3142C	Antennas	00078838	NCR	NCR
494	Omega	iBTHX-W	Climate Monitoring Equipment	9460211	8/1/2016	8/1/2018
RE112	Rohde & Schwarz	ESIB26	Receiver	836119/012	7/13/2016	7/13/2017

Open Area Test Site

AssetID	Manufacturer	Model#	Equipment Type	Serial#	Calibration Performed Date	Calibration Due Date
90	Electro-Metrics	LPA25	Antennas	1476	12/10/2015	12/10/2017
193	ACS	OATS Cable Set	Cable Set	0193	7/21/2016	7/21/2017
211	Eagle	C7RFM3NFNM	Filters	HLC-700	10/13/2016	10/13/2017
213	TEC	PA 102	Amplifiers	44927	8/8/2016	8/8/2017
486	Hewlett Packard	8591E	Analyzers	3543A04709	7/12/2016	7/12/2017
544	ETS Lindgren	3110B	Antennas	3361	12/7/2015	12/7/2017

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 30MHz – 6GHz. Quasi-Peak measurements are taken with the Spectrum Analyzer's resolution bandwidth was set to 120KHz and video bandwidth set to 300 kHz for measurements below 1000MHz. Average measurements above 1000MHz are taken using measurement instruments average detector. The calculation for the radiated emissions field strength is as follows:

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

4.1.3.3 Test Criteria

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

4.1.3.4 Test Justification

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

4.1.4 Test Setup Photographs

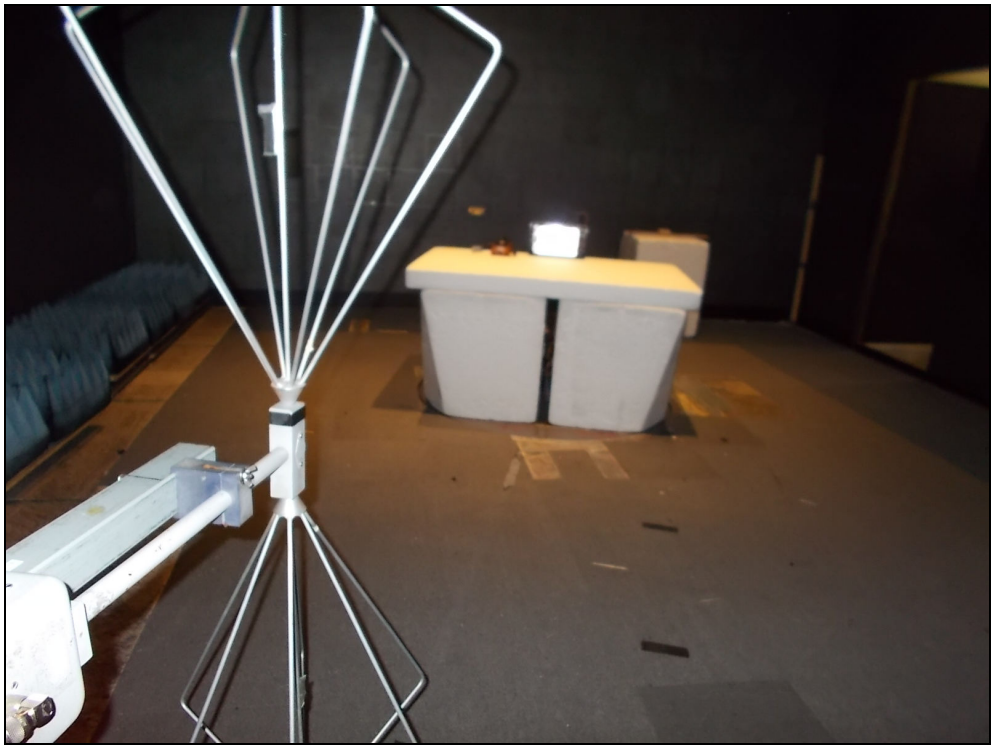


Figure 4.1.4-1: Radiated Emissions - Front View

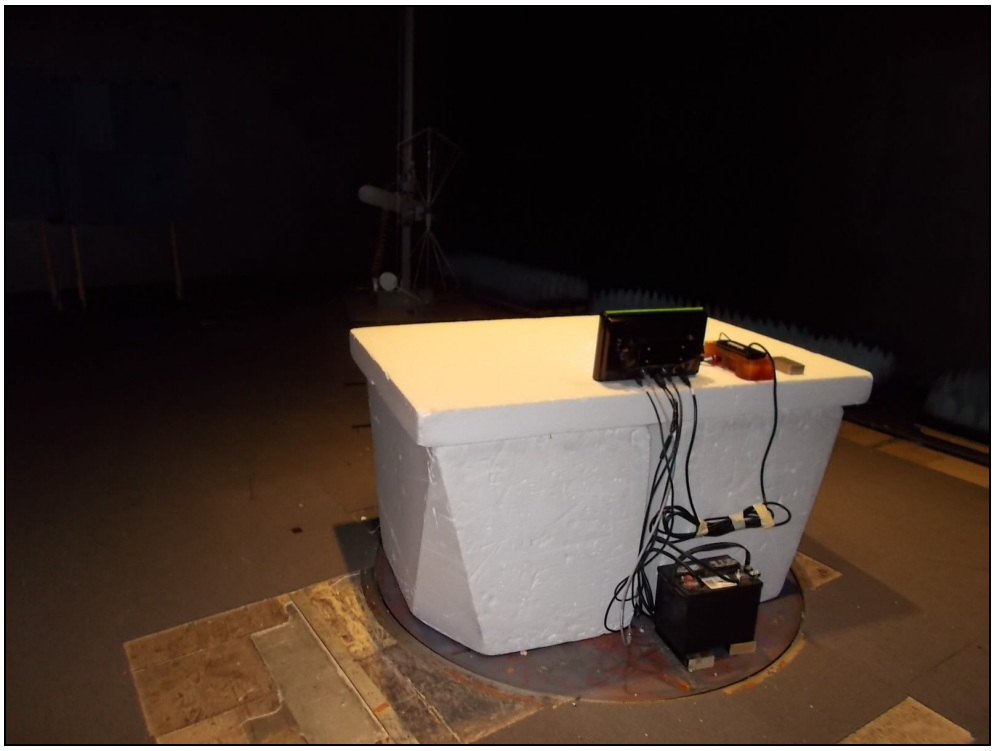


Figure 4.1.4-2: Radiated Emissions - Rear View

4.1.5 Test Data

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

Test Parameters:

Test Date:	**12/6/2016**	**Temperature (ºC)**	**22**
Technician:	**Art Sumner**	**Humidity (%)**	**44**
Equipment Class:	**Class B**	**Barometric Pressure (mBar)**	**1010**
Tested Modes:	**Powered ON, GPS active, monitoring depth**		
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
32.1	59.00	43.90	v	100	354	-12.85	---------	31.05	--------	40.5	---------	9.4
60.6	56.40	43.70	v	100	92	-13.97	---------	29.73	--------	40.5	---------	10.7
75.1	68.10	55.10	v	131	241	-17.51	---------	37.59	--------	40.5	---------	2.9
77.2	67.70	54.20	V	100	272	-17.68	---------	36.52	--------	40.5	---------	3.9
136.5	58.70	43.00	H	100	155	-12.68	---------	30.32	--------	40.5	---------	10.1
135.9	59.90	47.00	V	100	154	-12.73	---------	34.27	--------	40.5	---------	6.2
208.5	52.80	38.80	H	100	90	-12.63	---------	26.18	--------	40.5	---------	14.3
32.1	59.00	43.90	v	100	354	-12.85	---------	31.05	--------	40.5	---------	9.4

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 Conducted Emissions Test Site

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

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

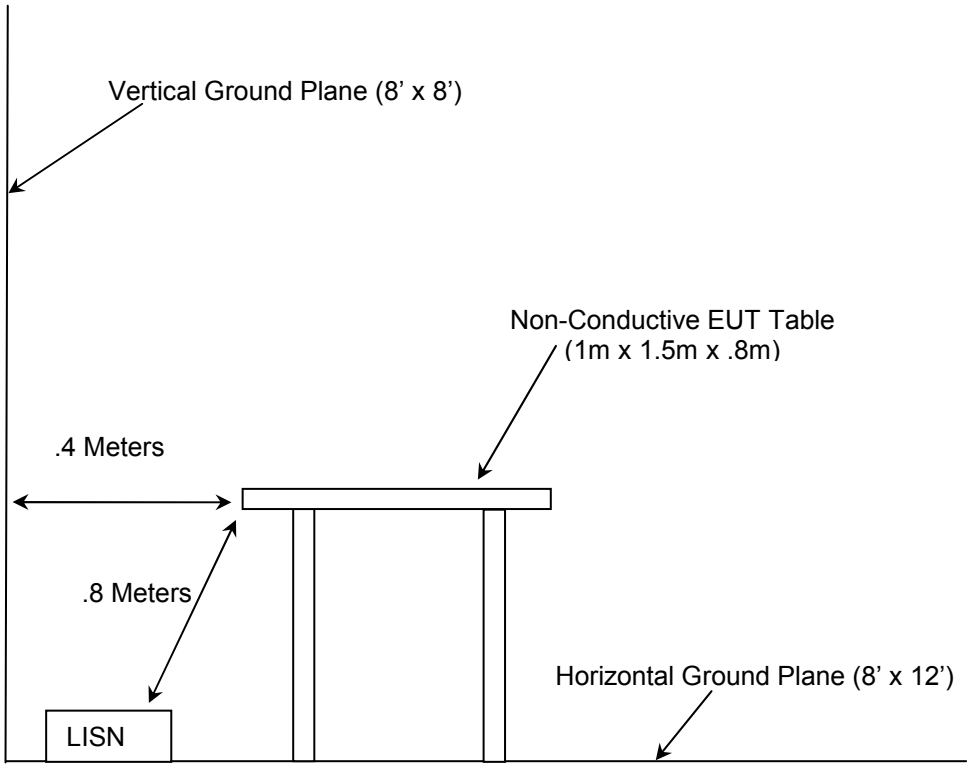


Figure 4.2.1-1: AC Mains Conducted EMI Site

4.2.2 Test Equipment

Table 4.2.2-1 Test Equipment – Conducted Emissions

AssetID	Manufacturer	Model#	Equipment Type	Serial#	Calibration Performed Date	Calibration Due Date
324	ACS	Belden	Cables	8214	5/2/2016	5/2/2017
494	Omega	iBTHX-W	Climate Monitoring Equipment	9460211	8/1/2016	8/1/2018
3010	Rohde & Schwarz	ENV216	LISN	3010	7/11/2016	7/11/2017
RE112	Rohde & Schwarz	ESIB26	Receiver	836119/012	7/13/2016	7/13/2017

Conducted Emissions Telecom

AssetID	Manufacturer	Model#	Equipment Type	Serial#	Calibration Performed Date	Calibration Due Date
168	Hewlett Packard	11947A	Attenuators	44829	1/8/2016	1/8/2017
324	ACS	Belden	Cables	8214	5/2/2016	5/2/2017
419	Teseq	ISN T800	LISN	25203	8/4/2016	8/4/2017
494	Omega	iBTHX-W	Climate Monitoring Equipment	9460211	8/1/2016	8/1/2018
561	Teseq	ISN ST08	Coupler	31286	7/11/2016	7/11/2017

NCR = No Calibration Required

4.2.3 Test Methodology

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

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

4.2.3.1 Test Criteria

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

4.2.3.2 Test Justification

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

4.2.4 Test Setup Photographs

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

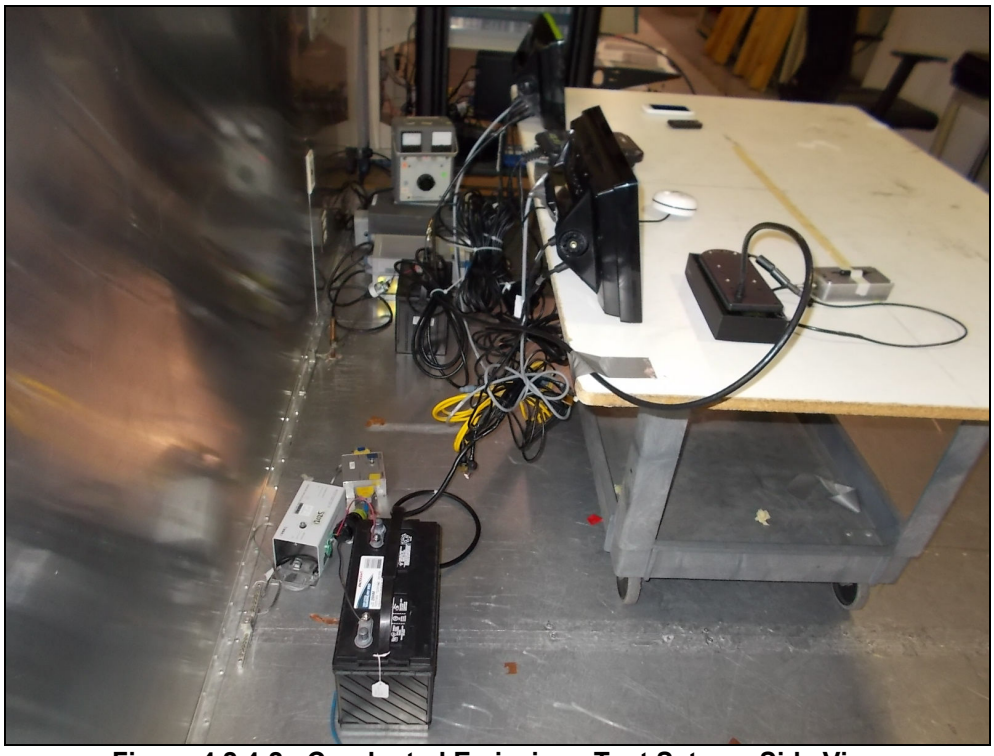


Figure 4.2.4-2: Conducted Emissions Test Setup – Side View

4.2.5 Test Data

Tabulated data is given in the Test Data Tables below.

Test Parameters:

Test Date:	**12/7/2016**	**Temperature (ºC)**	**21**
Technician:	**Art Sumner**	**Humidity (%)**	**44**
Equipment Class:	**B**	**Barometric Pressure (mBar)**	**1011**
Tested Modes:	**Powered ON; GPS and BT active, monitoring depth**		
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**

Test Data Tables:

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

Power Supply Description: 12Vdc

Frequency (MHz)	Corrected Reading		Limit (dBuV)	Margin (dB)	Line	Correction (dB)
	Quasi-Peak (dBuV)	Average (dBuV)				
3.588076	---	18.82	46.00	27.18	L1	9.8
3.588076	36.93	---	56.00	19.07	L1	9.8
3.774850	---	19.98	46.00	26.02	L1	9.8
3.774850	38.01	---	56.00	17.99	L1	9.8
4.697094	---	25.35	46.00	20.65	L1	9.9
4.697094	50.19	---	56.00	5.81	L1	9.9
4.892886	---	26.28	46.00	19.72	L1	9.9
4.892886	52.31	---	56.00	3.69	L1	9.9
8.358217	---	33.43	50.00	16.57	L1	10.0
8.358217	39.94	---	60.00	20.06	L1	10.0
9.602305	---	26.12	50.00	23.88	L1	10.0
9.602305	37.55	---	60.00	22.45	L1	10.0

Notes:

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

Power Supply Description: 12Vdc

Frequency (MHz)	Corrected Reading		Limit (dBuV)	Margin (dB)	Line	Correction (dB)
	Quasi-Peak (dBuV)	Average (dBuV)				
1.236874	---	15.51	46.00	30.49	N	9.8
1.236874	32.10	---	56.00	23.90	N	9.8
3.462024	---	17.87	46.00	28.13	N	9.8
3.462024	32.78	---	56.00	23.22	N	9.8
4.555410	---	22.98	46.00	23.02	N	9.9
4.555410	33.99	---	56.00	22.01	N	9.9
5.121543	---	26.77	50.00	23.23	N	9.9
5.121543	44.95	---	60.00	15.05	N	9.9
5.197495	---	26.73	50.00	23.27	N	9.9
5.197495	34.42	---	60.00	25.58	N	9.9
8.895091	---	32.53	50.00	17.47	N	10.0
8.895091	41.20	---	60.00	18.80	N	10.0

Notes:

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

Power Supply Description: 12Vdc

Frequency (MHz)	Corrected Reading		Limit (dBuV)	Margin (dB)	Line	Correction (dB)
	Quasi-Peak (dBuV)	Average (dBuV)				
5.785771	---	46.77	64.00	17.23	Ethernet	19.2
5.785771	54.64	---	74.00	19.36	Ethernet	19.2
5.883228	---	29.32	64.00	34.68	Ethernet	19.2
5.883228	52.43	---	74.00	21.57	Ethernet	19.2
6.122648	---	28.12	64.00	35.88	Ethernet	19.2
6.122648	46.21	---	74.00	27.79	Ethernet	19.2
6.182164	---	34.90	64.00	29.10	Ethernet	19.2
6.182164	44.45	---	74.00	29.55	Ethernet	19.2
18.241884	---	60.53	64.00	3.47	Ethernet	19.5
18.241884	63.74	---	74.00	10.26	Ethernet	19.5
23.127255	---	59.44	64.00	4.56	Ethernet	19.7
23.127255	62.86	---	74.00	11.14	Ethernet	19.7

Notes:

5.0 Harmonic Current Emissions

5.1 Test Justification

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

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

6.0 Voltage Fluctuations & Flicker

6.1 Test Justification

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

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

SECTION C: IMMUNITY – TEST INFORMATION AND RESULTS

7.0 Electrostatic Discharge Immunity

7.1 Test Site Description

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

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

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

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

7.2 Test Equipment

Table 7.2-1: Test Equipment List

AssetID	Manufacturer	Model#	Equipment Type	Serial#	Calibration Performed Date	Calibration Due Date
144	Omega	RH411	Climate Monitoring Equipment	H0103373	9/1/2016	9/1/2018
371	Fluke	Fluke 115	Meters	93872717	7/14/2016	7/14/2018
582	Kikusui	KES4021 A	ESD Gun	SA003046	4/28/2016	4/28/2017

NCR = No Calibration Required

7.3 Test Methodology

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

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

Direct Contact Discharge

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

Indirect Contact Discharge

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

Air Discharge

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

7.3.1 Test Criteria

EN 301 489-3 V1.6.1 and EN 301 489-17 V2.2.1 requires performance criterion B to be met as described in section 1.4.2.

7.3.2 Test Justification

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

7.4 Test Setup Photograph

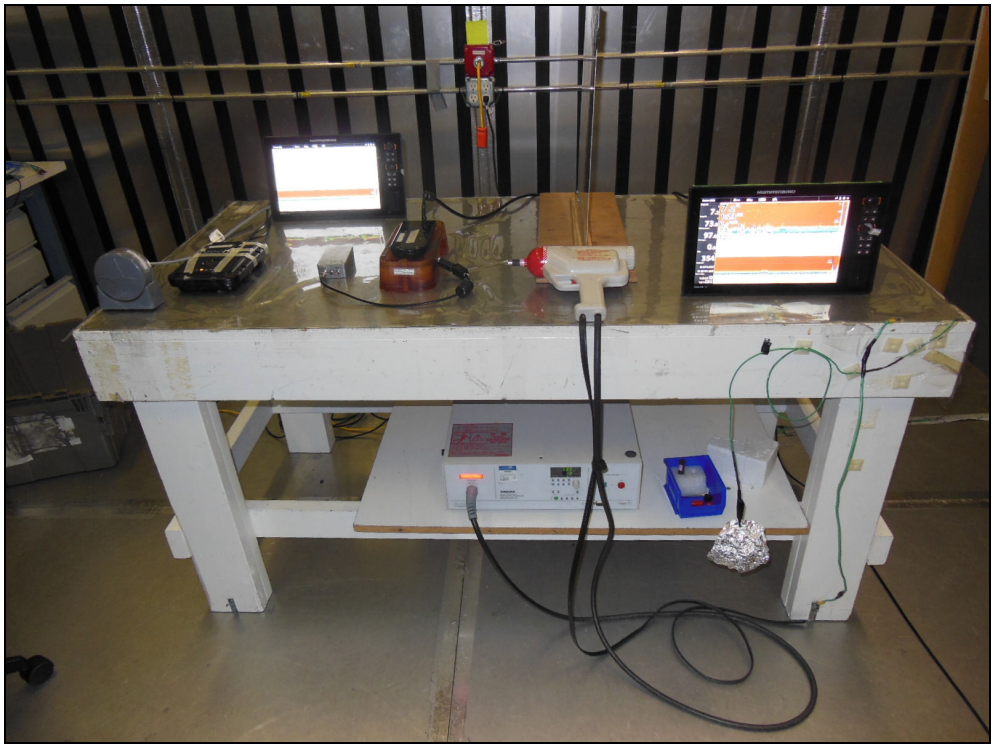
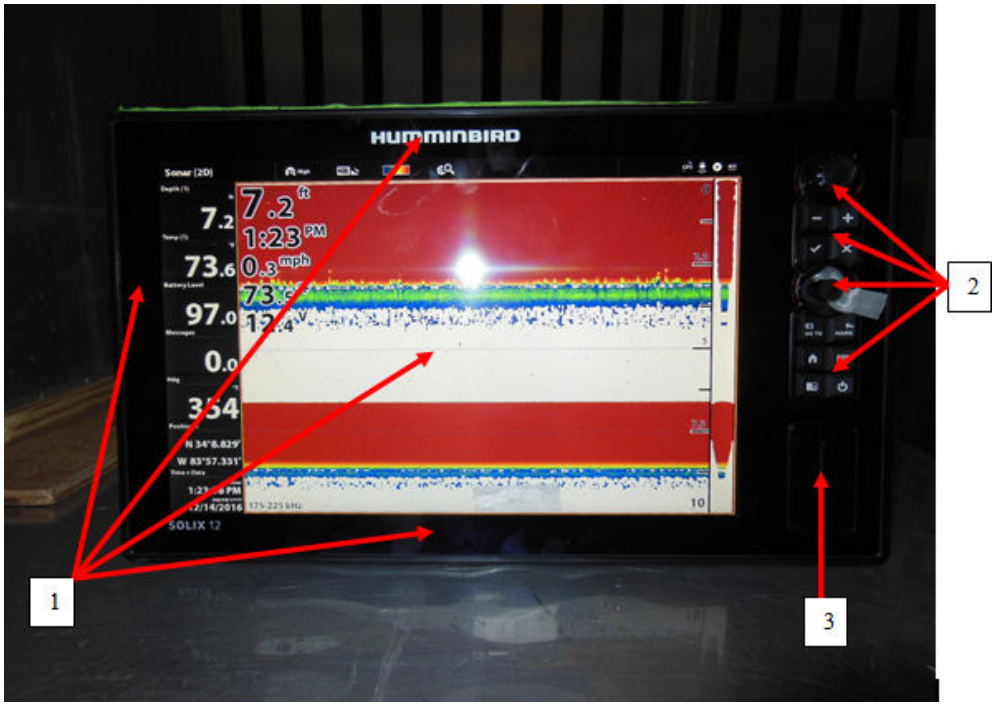
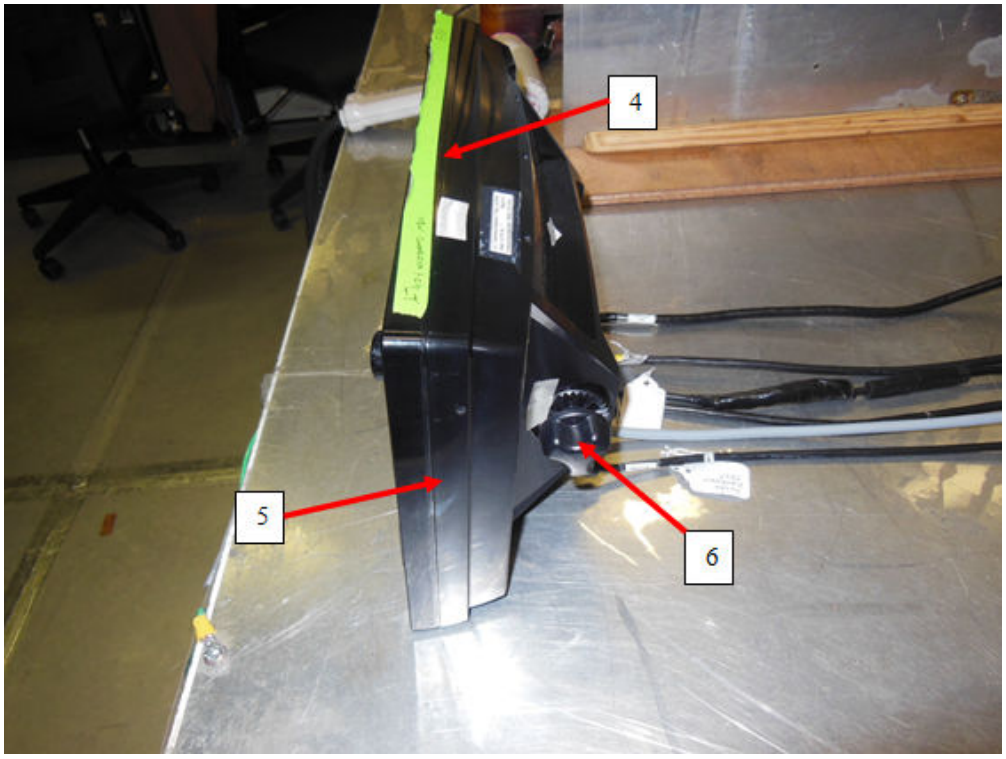


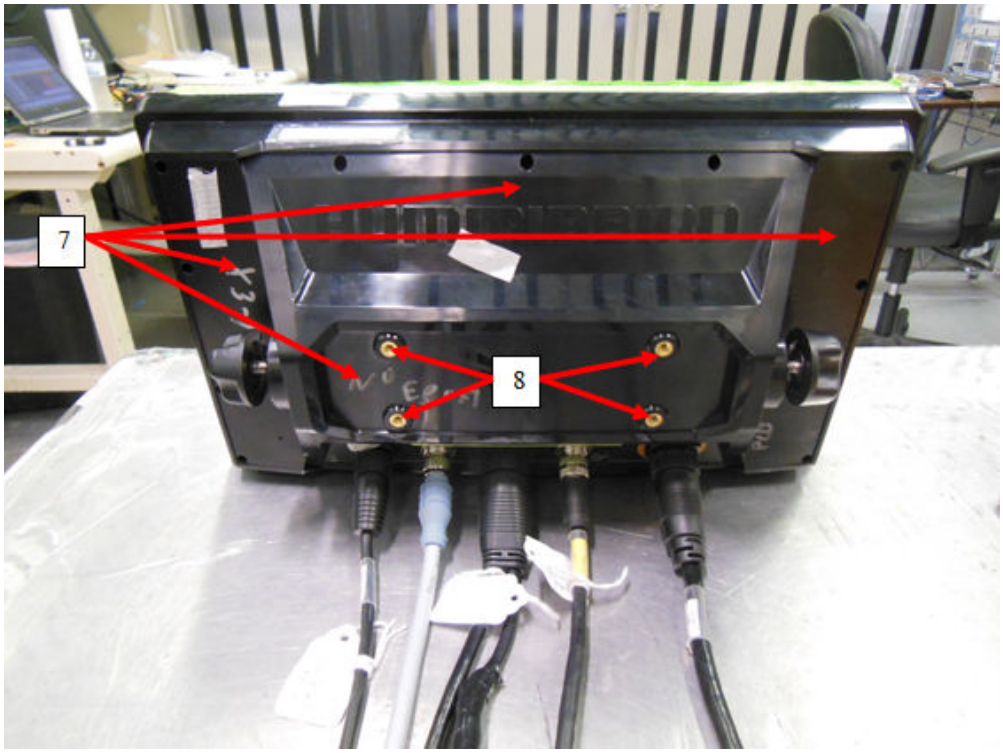
Figure 7.4-1: Test Setup Photograph

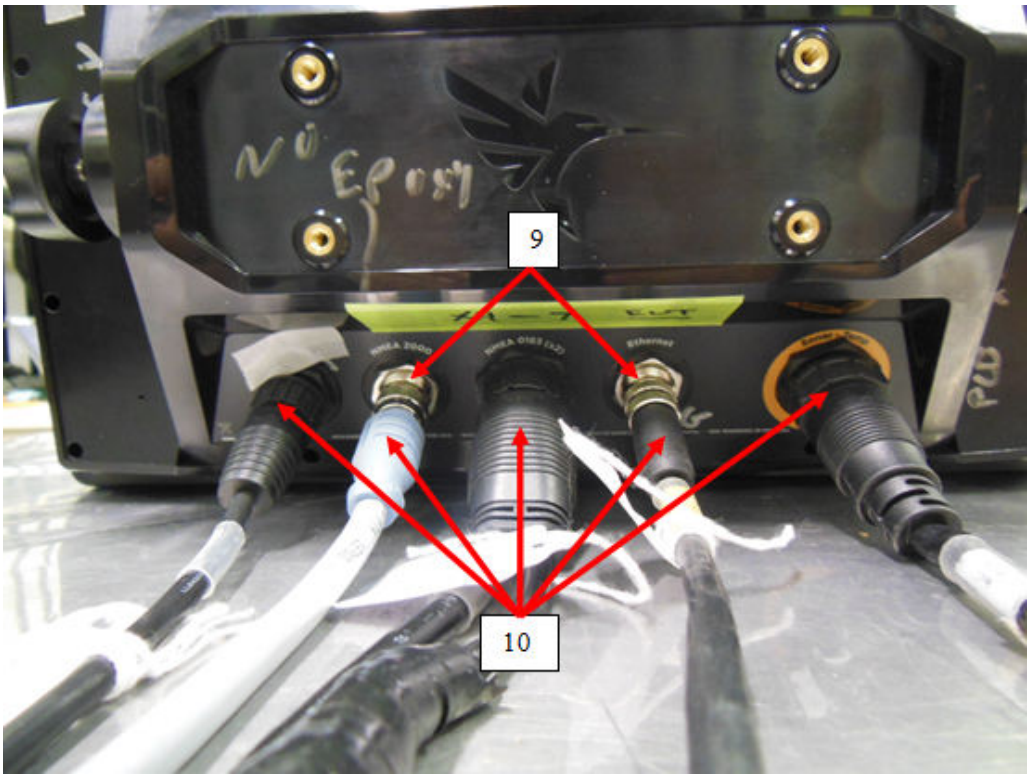
7.5 ESD Data Sheet

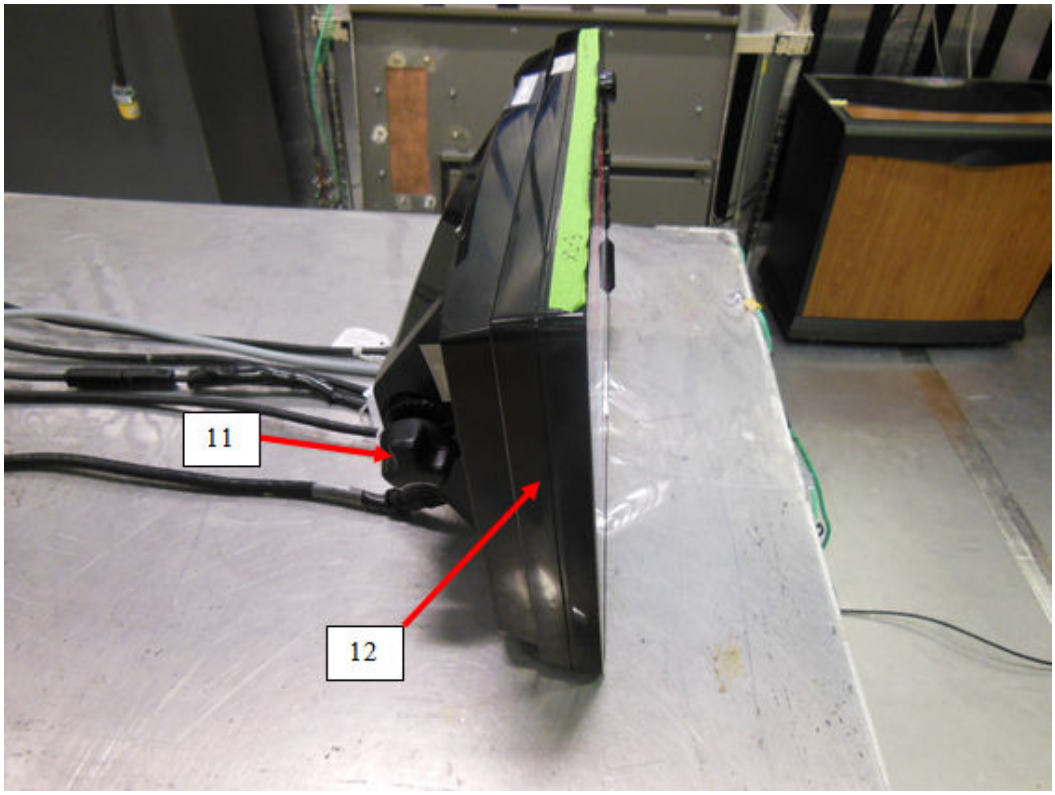
Test Point Photograph:






7
8


9
10



Test Point Selection:

TEST POINT#	DESCRIPTION	TYPE (C/A)	TEST POINT#	DESCRIPTION	TYPE (C/A)
1	Front, Display, Edges	**Air**	7	Back	**Air**
2	Buttons, Control knobs	**Air**	8	Mounting screw	**Contact**
3	Sides, Cover	**Air**	9	MMEA 2000 and Ethernet connectors	**Contact**
4	Top	**Air**	10	Cables and connectors	**Air**
5	Right side	**Air**	11	Mounting screw	**Air**
6	Mounting screw	**Air**	12	Left side	**Air**

7.6 Test Data

Test Parameters:

Test Date:	**December 14, 2016**	**Temperature (ºC)**	**26**
Technician:	**Sean Vick**	**Humidity (%)**	**43**
Equipment Class:	**N/A**	**Barometric Pressure (mBar)**	**1016.8**
		☒ **Pre-test Verification Complete**	
Tested Modes:	**EUT on; Connected to BT; GPS; Monitoring overall functionality**		
AC Input Power:	**N/A**	**VCP Resistor Value Check:**	**962k (Ohms)**
DC Input Power:	**12Vdc**	**HCP Resistor Value Check:**	**944k (Ohms)**

Indirect Contact Discharge:

Check All That Apply to This Data

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

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

Notes:

Air and Direct Contact Discharge:

Check All That Apply to This Data		
Polarity:	**Tested Levels:**	
☐ Positive	☒ 2kV	☒ 8kV
☐ Negative	☒ 4kV	☐ 15kV
☒ Both	☐ 6kV	☐ Enter Other Level Here

Test Point	Discharge Type	Result	Observation (Describe any detectable event)
1	Air	Pass	
2	Air	Pass	
3	Air	Pass	
4	Air	Pass	
5	Air	Pass	
6	Air	Pass	
7	Air	Pass	
8	Contact	Pass	
9	Contact	Pass	
10	Air	Pass	
11	Air	Pass	
12	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	6/17/2016	6/17/2017
354	ETS Lindgren	3142C	Antennas	00078838	NCR	NCR
370	IFI	CMX5002	Amplifier	L364-0407	NCR	NCR
494	Omega	iBTHX-W	Climate Monitoring Equipment	9460211	8/1/2016	8/1/2018
565	United Microwave Products, Inc.	OO-190-15.00.0	Cables	565	NCR	NCR
566	United Microwave Products, Inc.	OO-190-00-120.0	Cables	566	NCR	NCR
642	Fairview Microwave	FMC0101951-200CM	Cables	N/A	NCR	NCR
711	Hewlett Packard	8648B	Signal Generators	3623A01926	7/25/2016	7/25/2017
1112	Wandel & Goltermann	BN2244/21	Probes	H0006	12/3/2015	12/3/2016

High Frequency

AssetID	Manufacturer	Model#	Equipment Type	Serial#	Calibration Performed Date	Calibration Due Date
329	A.H. Systems	SAS-571	Antennas	721	7/22/2015	7/22/2017
494	Omega	iBTHX-W	Climate Monitoring Equipment	9460211	8/1/2016	8/1/2018
564	United Microwave Products, Inc.	AO-190-00.36.0	Cables	564	7/29/2016	7/29/2017
565	United Microwave Products, Inc.	OO-190-15.00.0	Cables	565	NCR	NCR
566	United Microwave Products, Inc.	OO-190-00-120.0	Cables	566	NCR	NCR
609	Rohde & Schwarz	SMB100A	Signal Generators	175334	8/16/2016	8/16/2018
1112	Wandel & Goltermann	BN2244/21	Probes	H0006	12/3/2015	12/3/2016
1115	Varian	VZC6961G1	Amplifier	884	NCR	NCR
1116	Varian	VZM6991G5	Amplifier	1147	NCR	NCR
RE89	Amplifier Research	25S1G4A	Amplifier	0324609	NCR	NCR

Semi-Anechoic Chamber

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
494	Omega	iBTHX-W	Climate Monitoring Equipment	9460211	8/1/2016	8/1/2018
619	Teledyne Storm Microwave	90-195-456	Cables	13-10-601	10/20/2016	10/20/2017
620	Teledyne Storm Microwave	90-195-456	Cables	13-10-602	10/20/2016	10/20/2017
624	Advantest	R3261C	Spectrum Analyzers	31720426	NCR	NCR
1112	Wandel & Goltermann	BN2244/21	Probes	H0006	12/3/2015	12/3/2016

NCR = No Calibration Required

8.3 Test Methodology

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

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

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

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

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

8.3.1 Test Criteria

EN 301 489-3 V1.6.1 and EN 301 489-17 V2.2.1 requires criterion A to be met as described in section 1.4.2.

8.3.2 Test Justification

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

8.4 Test Setup Photographs

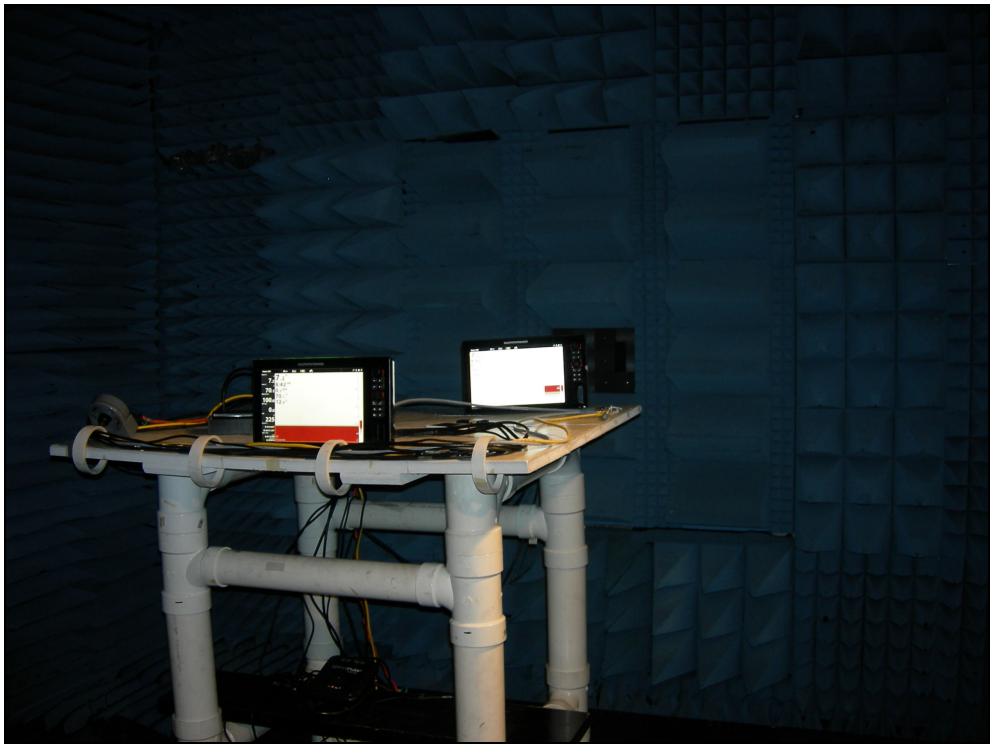


Figure 8.4-1: Test Setup Photograph

8.5 Test Results

Test Parameters:

Test Date:	**December 9, 2016**	**Temperature (ºC)**	**23**
Technician:	**Tommy Payton**	**Humidity (%)**	**30**
Equipment Class:	**N/A**	**Barometric Pressure (mBar)**	**1028**
Tested Modes:	**Monitoring Depth, Speed, Temperature, Bluetooth Connection, Heading, GPS, Network Connection**		
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	☒ 1400-2700MHz	☐ 3 Seconds
☒ Both	☐ 8V/m	☐ Enter Other Band Here	☐ Enter Other
	☐ Enter Other Level Here		

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

Notes:

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	7/15/2016	7/15/2017
474	Keytek	EMC PRO	General Lab Equipment	9808246	10/7/2015	12/7/2016
494	Omega	iBTHX-W	Climate Monitoring Equipment	9460211	8/1/2016	8/1/2018

NCR = No Calibration Required

9.3 Test Methodology

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

9.3.1 Test Criteria

EN 301 489-3 V1.6.1 and EN 301 489-17 V2.2.1 requires criterion B to be met as described in section 1.4.2.

9.3.2 Test Justification

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

9.4 Test Setup Photographs

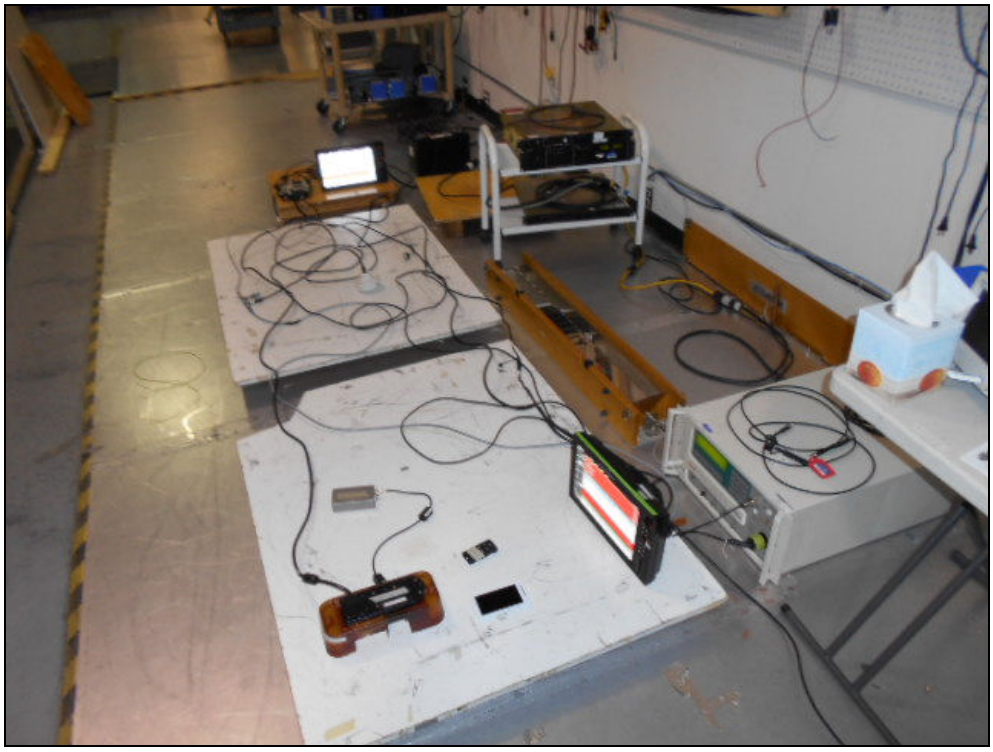


Figure 9.4-1: Test Setup Photograph

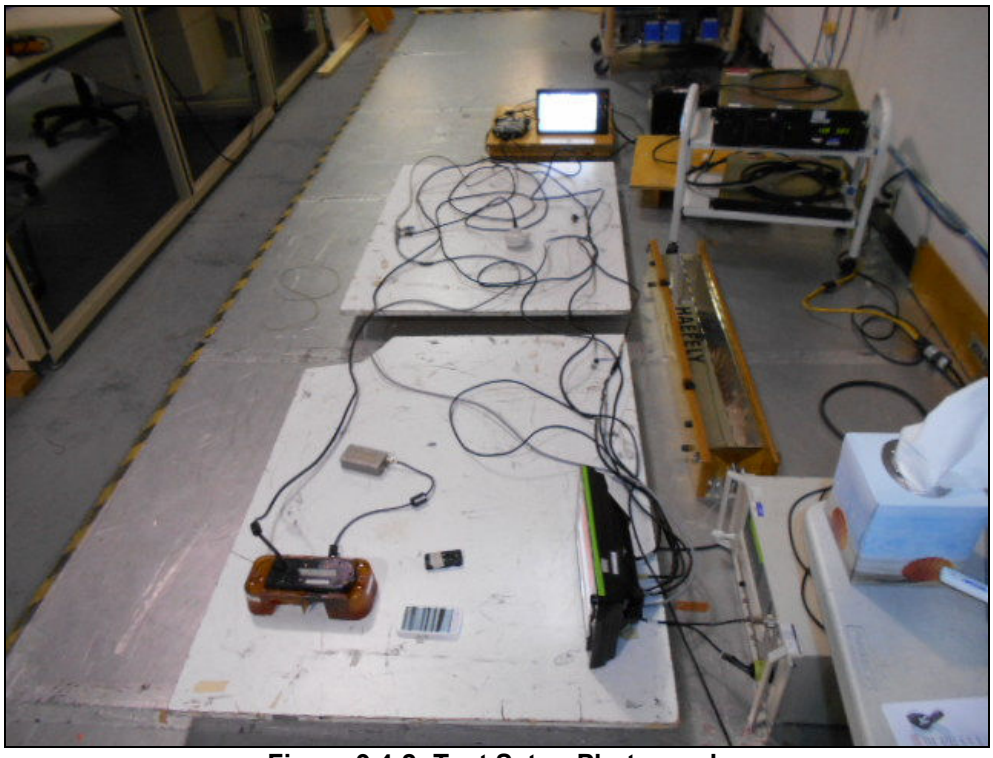


Figure 9.4-2: Test Setup Photograph

9.5 Test Results

Test Parameters:

Test Date:	**12/18/2016**	**Temperature (ºC)**	**25**
Technician:	**Christopher O'Steen**	**Humidity (%)**	**36**
Equipment Class:	**N/A**	**Barometric Pressure (mBar)**	**1018**
Tested Modes:	**Powered ON; connected to AE unit via Ethernet. GPS, Depth, temp, GEOGPS, BT, and remote all connected and monitored during testing.**		
AC Input Power:	**N/A**	☒ **Pre-test Verification Complete**	
DC Input Power:	**12VDC**		

Mains Test Data:

Check All That Apply to This Data

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

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

Notes:

Signal Line Test Data:

Check All That Apply to This Data

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

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

Notes:

10.0 Surge Immunity

10.1 Test Justification

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

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

11.0 Radio-Frequency Common-Mode Immunity

11.1 Test Site Description

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

11.2 Test Equipment

Table 11.2-1: Test Equipment List

AssetID	Manufacturer	Model#	Equipment Type	Serial#	Calibration Performed Date	Calibration Due Date
5	Chase	CSP-8441	Probes	19	5/24/2016	5/24/2017
93	Chase	8101	Clamp	65	5/6/2016	5/6/2017
96	Chase	1000-M3-25	CDN	9806	3/10/2016	3/10/2017
364	Amplifier Research	DC2600A	Coupler	0322466	NCR	NCR
370	IFI	CMX5002	Amplifier	L364-0407	NCR	NCR
418	Teseq	ISN-S501	LISN	24543	3/16/2016	3/16/2017
425	ACS	EMC Cable Set	Cable Set	425	NCR	NCR
457	Com Power	CDN-M2-25	Coupler	511023	7/13/2016	7/13/2017
471	Bird Technologies Group	150-A-FFN-06	Attenuators	0914	NCR	NCR
494	Omega	iBTHX-W	Climate Monitoring Equipment	9460211	8/1/2016	8/1/2018
634	Fischer Custom Communications Inc.	FCC-801-M3-16	CDN	9730	4/26/2016	4/26/2017
711	Hewlett Packard	8648B	Signal Generators	3623A01926	7/25/2016	7/25/2017

NCR = No Calibration Required

11.3 Test Methodology

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

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

11.3.1 Test Criteria

EN 301 489-3 V1.6.1 and EN 301 489-17 V2.2.1 requires criterion A to be met as described in section 1.4.2.

11.3.2 Test Justification

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

11.4 Test Setup Photographs

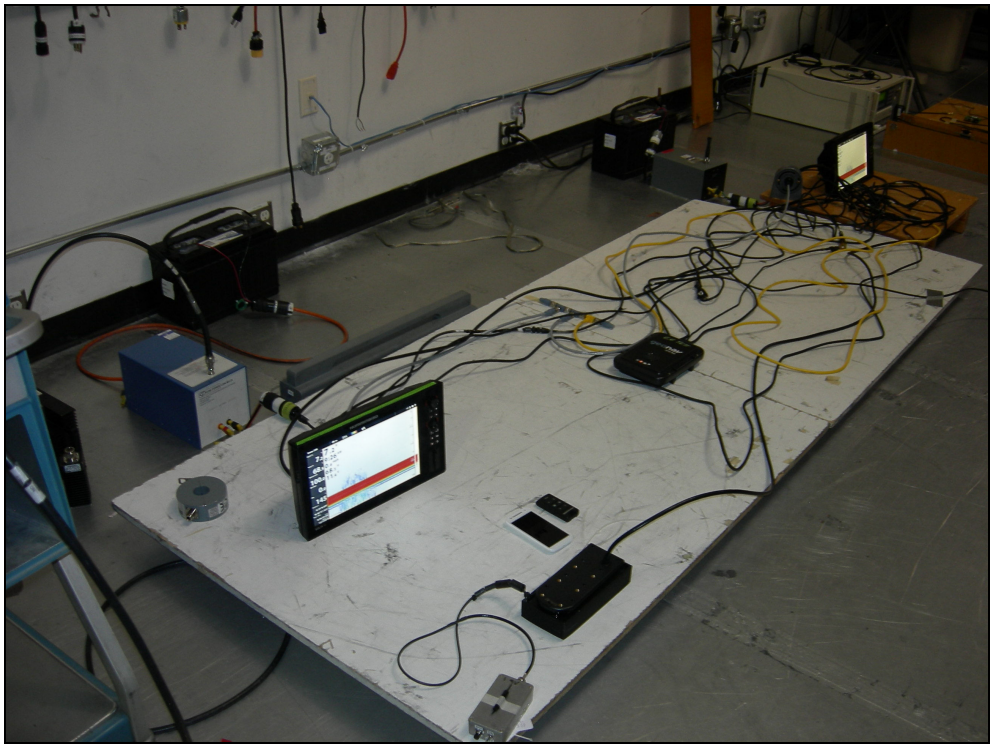


Figure 11.4-1: Test Setup Photograph

11.5 Test Results

Test Parameters:

Test Date:	**December 7, 2016**	**Temperature (ºC)**	**24**
Technician:	**Tommy Payton**	**Humidity (%)**	**41**
Equipment Class:	**N/A**	**Barometric Pressure (mBar)**	**1016**
Tested Modes:	**Monitoring Depth, Speed, Temperature, Bluetooth Connection, Heading, GPS, Network Connection.**		
AC Input Power:	**N/A**	☒ **Pre-Test Verification**	
DC Input Power:	**12Vdc**		

Mains Test Data:

Check All That Apply to This Data

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

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

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

Notes:

Signal Line Test Data:

Check All That Apply to This Data

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

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

Signal Line	Result	Observation (Describe any detectable event)
Transducer Cable	Pass	
GPS Cable	Pass	
AIS Module Cable	Pass	
Ethernet Cable	Pass	
NMEA2K GPS Cable	Pass	

Notes:

12.0 Power Frequency Magnetic Fields Immunity

12.1 Test Justification

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

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

13.0 Voltage Dips and Interruptions

13.1 Test Justification

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

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

SECTION D: MEASUREMENT UNCERTAINTY

General
Measurement Uncertainty is based on the following publications:

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

Calculations for measurement uncertainty are available upon request.

Emissions:

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

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

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

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

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

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

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

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