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EMC Technical Report

Prepared For: Johnson Outdoors Marine Electronics, Inc

Model Covered: SOLIX 15 SI (410420-1)

Model Variants: Solix 15, Solix 12 SI, Solix 12

**In Accordance with:
Radio Equipment Directive (RED) – 2014/53/EU**

Product Standard: EN 301 489-19 V2.1.0, EN 55032:2012, and EN 55024:2010 with respect to EN 301 489-1 V2.2.0 (Guide EG203367 V1.1.1)

Report Number: AT72128131.5R2

Report Revision: C

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This report contains Page 43 pages



America

TÜV SÜD America Inc., 5015 B.U. Bowman Drive, Buford, GA 30518
Tel: (770) 831-8048. Website: www.TUVamerica.com

Project Manager:

Sean Vick
EMC Technician
TÜV SÜD America Inc.

Reviewed by:

Forrest Duncan
Senior EMC Engineer
TÜV SÜD America Inc.

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REVISION HISTORY
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Project Information Sheet

Applicant Details

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

Phone: (770) 888-6292 x1049

Fax:

Email: nrmedio@johnsonoutdoors.com

Sample Information

Model: SOLIX 15 SI (410420-1)

Model Variant(s): Solix 15, Solix 12 SI, Solix 12

Environment of Use: Residential

Sample Receive Date: May 19, 2017

Sample Receive Condition: Good

Test Mode Description: EUT and GPS active running on battery power; 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 15 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 15 is identical to the SOLIX 15 SI with the exception of the SW load that limits sonar to traditional 2D only.

The Solix 12 is the same as the Solix 15 with the exception of the display size.

410410-1	Solix 15
410390-1	Solix 12
410400-1	Solix 12 SI

Test Information

Test Start Date: May 25, 2017

Test End Date: June 12, 2017

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.

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SECTION A: GENERAL INFORMATION

1.0 Introduction

1.1 Scope

This report documents conformance with the requirements set forth in EN 301 489-19 V2.1.0, EN 55032:2012, and EN 55024:2010 with respect to EN 301 489-1 V2.2.0 and details the results of testing performed on May 25, 2017 through June 12, 2017 on the model SOLIX 15 SI (410420-1) manufactured by Johnson Outdoors Marine Electronics, Inc.

The purpose of this test report is to document the gap analysis testing performed on the SOLIX 15 SI (410420-1) to bring it into compliance with the current RE Directive and applicable product standards. The original test data can be found in ACS report number 16-0527.C09.3A.

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 V2.2.0	Electromagnetic compatibility and Radio spectrum Matters (ERM); ElectroMagnetic Compatibility (EMC) standard for radio equipment and services; Part 1: Common technical requirements	Pass
EN 301 489-19 V2.1.0	ElectroMagnetic Compatibility (EMC) standard for radio equipment and services; Part 19: Specific conditions for Receive Only Mobile Earth Stations (ROMES) operating in the 1,5 GHz band providing data communications and GNSS receivers operating in the RNSS band (ROGNSS) providing positioning, navigation, and timing data; Harmonised Standard covering the essential requirements of article 3.1(b) of Directive 2014/53/EU	Pass
EN 55032:2012	Electromagnetic compatibility of multimedia equipment – Emission requirements	Pass
EN 55024:2010	Information technology equipment – Immunity characteristics – Limits and methods of measurement	Pass
EN 61000-3-2:2014	Electromagnetic compatibility (EMC) -- Part 3-2: Limits - Limits for harmonic current emissions (equipment input current \leq 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 \leq 16 A per phase and not subject to conditional connection	N/A
Basic Immunity Standards per EN 301 489-19/EN 55024		
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 2 nd Ed.	Electromagnetic compatibility (EMC) - Part 4-5: Testing and measurement techniques - Surge immunity test	N/A
IEC 61000-4-6 3 rd 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 2 nd Ed.	Electromagnetic compatibility (EMC) - Part 4-8: Testing and measurement techniques - Power frequency magnetic field immunity test	N/A
IEC 61000-4-11 2 nd 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 15 SI (410420-1) 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

2 – (V) Indicates voltage limits in dBμV

3 – (I) Indicates current limits in dBμA

4 – Limits <1GHz are Quasi-Peak and Peak >1GHz

Note: Lower Limit Applies at Transition Frequency

1.4.2 Harmonic Current Emissions Criteria

Harmonic current emissions for Class A equipment must not exceed the levels as given in table 1.4.2-1 below:

Table 1.4.2-1

Harmonic Order (n)	Maximum Permissible Harmonic Current (A)
Odd Harmonics	
3	2.30
5	1.14
7	0.77
9	0.40
11	0.33
13	0.21
$15 \leq n \leq 39$	$0.15(15/n)$
Even Harmonics	
2	1.08
4	0.43
6	0.30
$8 \leq n \leq 40$	$0.23(8/n)$

1.4.3 Voltage Fluctuations & Flicker Criteria

The following limits apply:

- The value of P_{ST} shall not be greater than 1.0
- The value of P_{LT} shall not be greater than .65
- The relative steady-state voltage change, d_c , shall not exceed 3.3%
- The maximum voltage change, d_{max} , shall not exceed 4%
- The relative voltage change characteristics value of $d(t)$ during a voltage change shall not exceed 3.3% for more than 200mS.

Where:

- P_{ST} is the short term flicker indicator. The flicker severity is evaluated over a short period (in minutes). $P_{ST} = 1$ is the conventional threshold of irritability.
- P_{LT} is the long term flicker indicator. The flicker severity is evaluated over a long period (in hours) using successive P_{ST} values.
- $d(t)$, d_{max} and d_c are ratios of the absolute magnitudes to the phase-to-neutral values of the nominal voltages.

1.4.4 Immunity Performance Criteria

General performance criteria

If the EUT is of a non specialized nature or the EUT is combined with an ancillary equipment, the test modulation, test arrangements, etc. as required in clause 4 shall apply.

The EUT, for all immunity tests according to the present document, except the spot frequency test of the immunity test with radiated RF electromagnetic fields (see ETSI EN 301 489-1 [1], clause 9.2), shall be assessed for:

- the storage of messages in the memory of the EUT at the start of the test;
- unintentional responses of the EUT during the test;
- the maintenance of the EUT memory assessed at the conclusion of the test;
- the ability to receive and store messages at the conclusion of the test.

For the spot frequency test of the immunity test with radiated RF electromagnetic fields (see ETSI EN 301 489-1 [1], clause 9.2) the EUT shall be assessed by monitoring the accuracy of the call received alert signal.

Performance criteria for Continuous phenomena applied to ROMES and ROGNSS receivers (CR)

For the EUT, excluding spot frequency tests as part of the immunity test with radiated RF electromagnetic fields (see ETSI EN 301 489-1 [1], clause 9.2):

- the general performance criteria set out in clause 6.1;
- during the test no false calls shall occur;
- at the conclusion of the test comprising the series of individual exposures the EUT shall operate as intended with no loss of functions or stored data (messages), as declared by the manufacturer.

For the spot frequency test as part of the immunity test with radiated RF electromagnetic fields (see ETSI EN 301 489-1 [1], clause 9.2) the EUT shall be assessed by monitoring the accuracy of the call received alert signal.

Performance criteria for Transient phenomena applied to ROMES and ROGNSS receivers (TR)

For the EUT:

- the general performance criteria set out in clause 6.1;
- during the test no false calls shall occur;
- at the conclusion of the test comprising the series of individual exposures, the EUT shall operate as intended with no loss of function and/or stored data (messages), as declared by the manufacturer.

Performance criteria for equipment which does not provide a continuous communication link

The provision of ETSI EN 301 489-1 [1], clause 6.3 shall apply with the following modifications.

For EUTs of a specialized nature and/or ancillary equipment tested on a stand alone basis the manufacturer shall define the method of test to determine the acceptable level of performance or degradation of performance during and/or after the test. Under these circumstances the manufacturer will also provide the following information:

- the primary functions of the equipment to be tested during and after EMC stress;
- the intended functions of the EUT which shall be in accordance with the documentation accompanying the equipment;
- the pass/failure criteria for the equipment;
- the method of observing a degradation of performance of the equipment.

The assessment of the performance or the degradation of performance which shall be carried out during and/or at the conclusion of the tests, shall be simple, but at the same time give adequate proof that the primary functions of the equipment are operational.

2.0 Test Facilities & Environment

2.1 Test Facilities

All testing was performed at the following address:

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 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 Ln
Eufaula, AL 36027
Nancy Rimedio
(770) 888-6292 x1049
nrimedio@johnsonoutdoors.com

3.2 Modifications

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

Table 3.2-1: EUT Modifications

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

3.3 System Block Diagram and Support Equipment

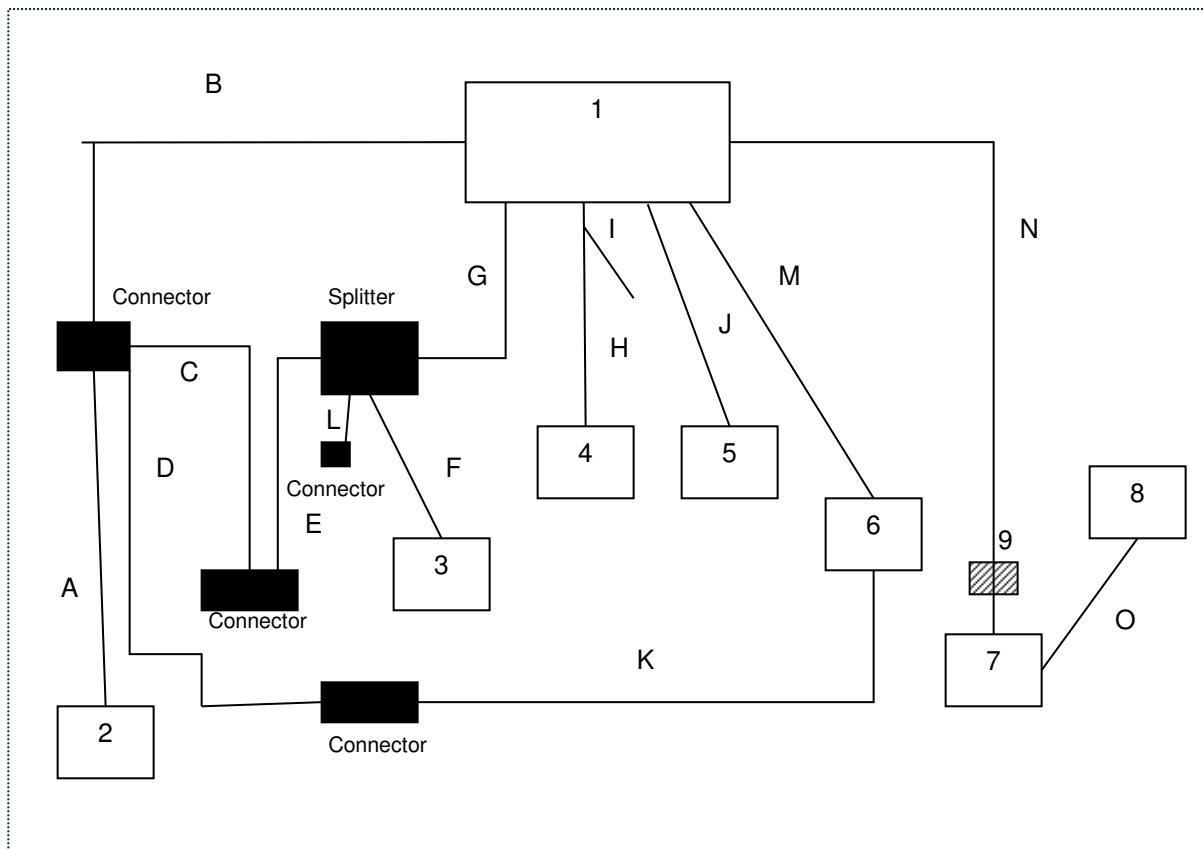


Figure 3.3-1: System Block Diagram

Table 3.3-1: EUT and Support Equipment Description

Item #	Type Device	Manufacturer	Model/Part #	Serial #
1	EUT	Johnson Outdoors	SOLIX 15 SI	X4-2
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

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

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:

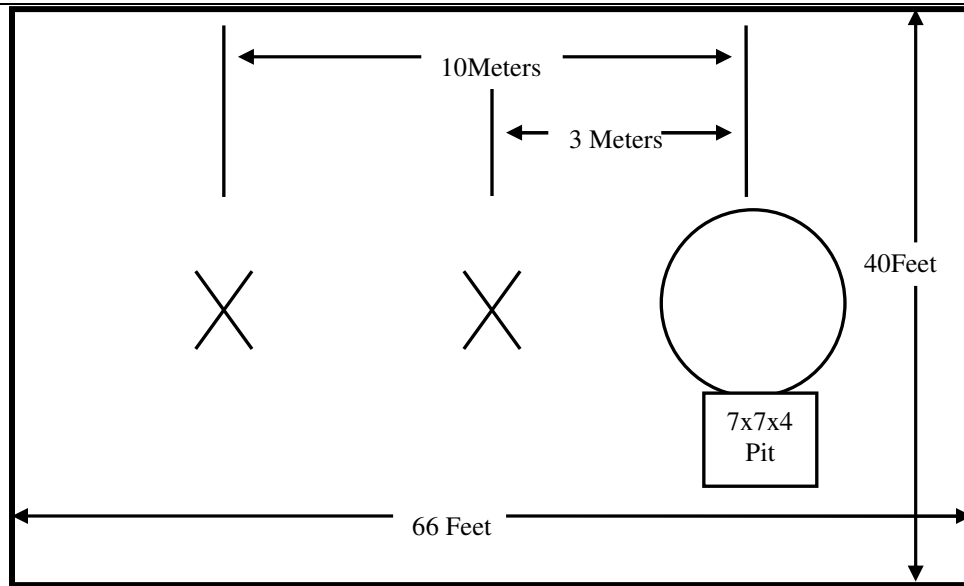


Figure 4.1.1.1-1: Open Area Test Site

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 3/4" 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:

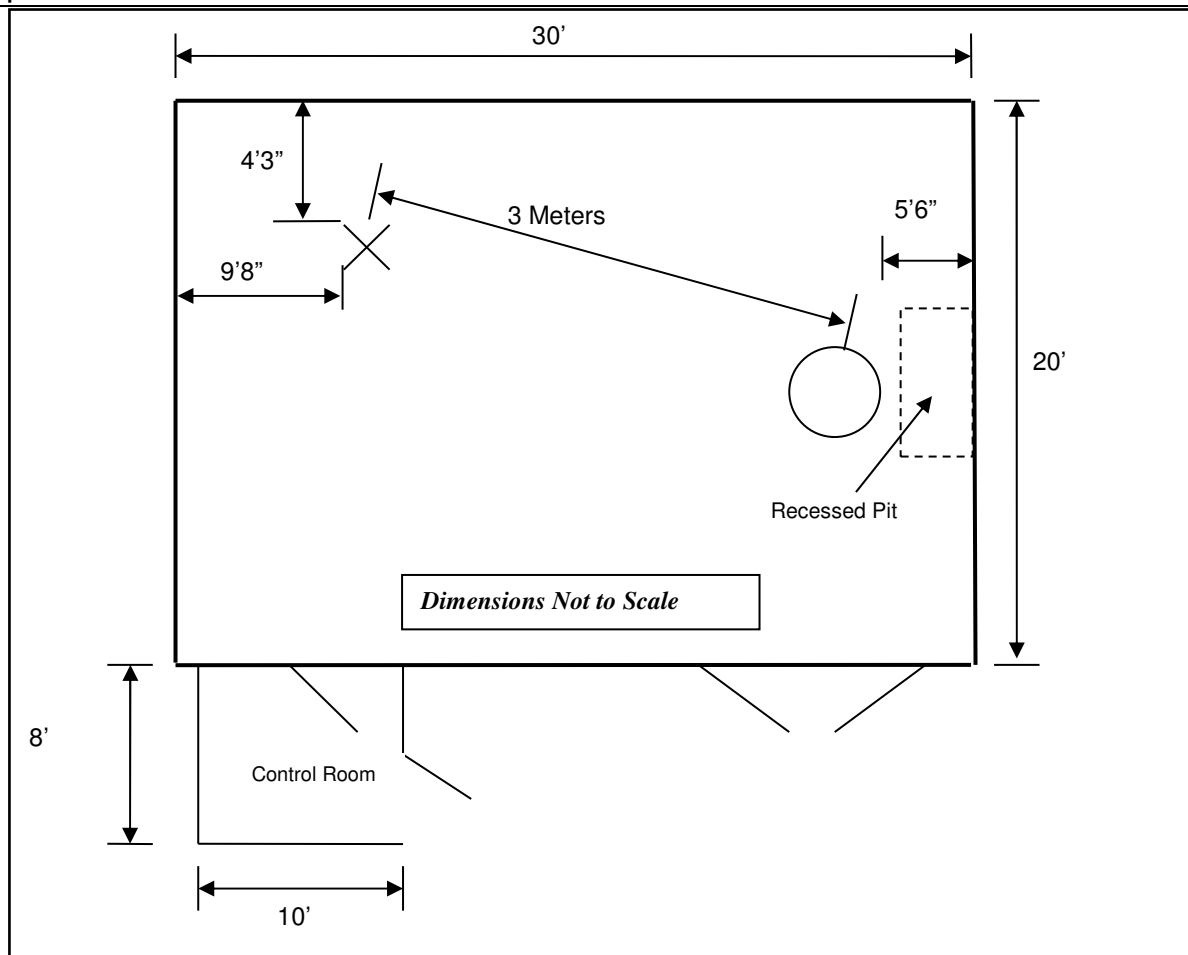


Figure 4.1.1.2-1: Semi-Anechoic Chamber Test Site

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:

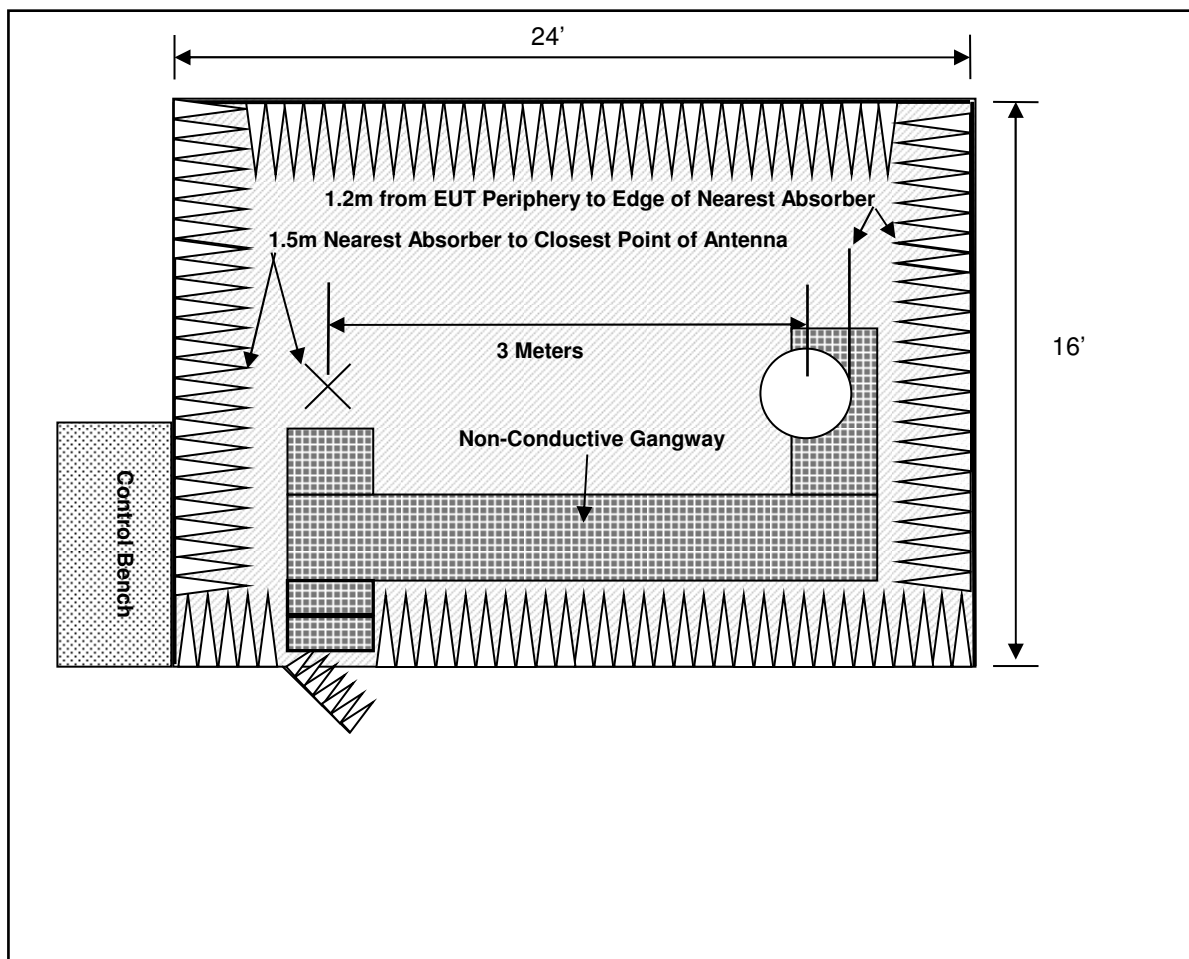


Figure 4.1.1.3-1: Fully Anechoic Chamber Test Site

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
RE135	Rohde & Schwarz	FSP30	Spectrum Analyzers	835618/031	10/31/2016	10/31/2017

Semi-Anechoic Chamber High Frequency

AssetID	Manufacturer	Model#	Equipment Type	Serial#	Calibration Performed Date	Calibration Due Date
30	Spectrum Technologies	DRH-0118	Antennas	970102	5/9/2017	5/9/2019
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
RE135	Rohde & Schwarz	FSP30	Spectrum Analyzers	835618/031	10/31/2016	10/31/2017

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
812	PMM	9030	Receiver	121WW30401	2/6/2017	2/6/2018
813	PMM	9010	Receiver	697WW30606	2/6/2017	2/6/2018

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	C7RFM3NFM	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 90° in both horizontal and vertical polarities and at antenna heights of 100cm and 300cm. Although not a fully maximized scan, the pre-scan gives a good indication of pass or fail.

4.1.3.2 Final Scans

Radiated emissions measurements were made over the frequency range of 30MHz to 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:

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

4.1.3.3 Test Criteria

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

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

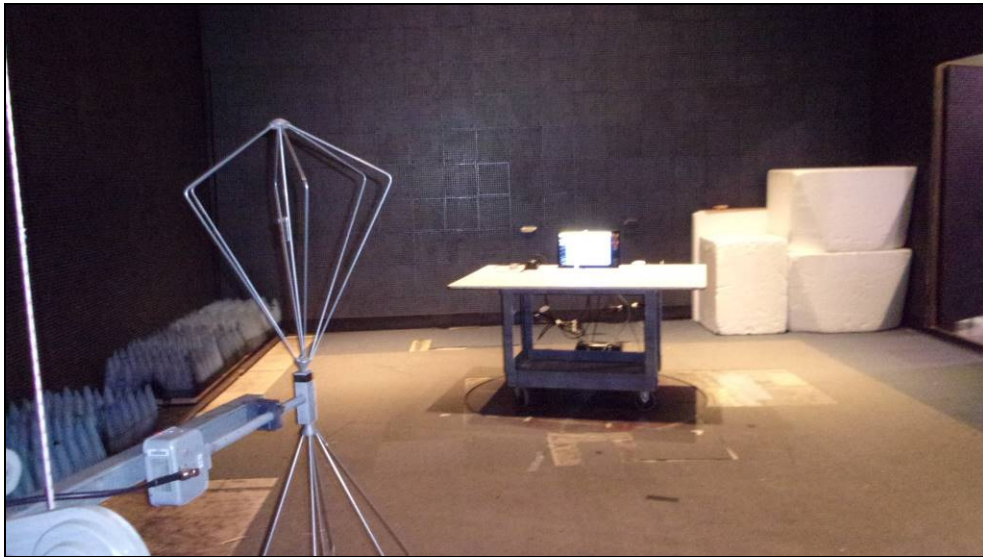


Figure 4.1.4-1: Radiated Emissions - Front View



Figure 4.1.4-2: Radiated Emissions - Rear View



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4.1.5 Test Data

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

Test Parameters:

Test Date:	6/1/2017	Temperature (°C)	23
Technician:	Wayne Orwig	Humidity (%)	41
Equipment Class:	B	Barometric Pressure (mBar)	1017
Tested Modes:	GPS&GNSS, transducer, simulator on table		
AC Input Power:	N/A		
DC Input Power:	12Vdc		

Test Data Table:

Measurement Distance:												
<input type="checkbox"/> FAC <input checked="" type="checkbox"/> SAC <input type="checkbox"/> OATS <input type="checkbox"/> 1 Meter <input checked="" type="checkbox"/> 3 Meter <input type="checkbox"/> 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
59.197		49.06	V	100	183	-13.88	-----	35.18	-----	40.5	-----	5.3
65.997		49.54	V	100	115	-14.78	-----	34.76	-----	40.5	-----	5.7
66.8		47.77	H	157	161	-15.00	-----	32.77	-----	40.5	-----	7.7
120.535		47.70	V	100	0	-11.36	-----	36.34	-----	40.5	-----	4.1
154.868		47.46	H	100	293	-10.12	-----	37.34	-----	40.5	-----	3.1
250		55.62	H	100	208	-11.70	-----	43.92	-----	47.5	-----	3.5
497.99		46.83	V	100	185	-3.74	-----	43.09	-----	47.5	-----	4.4
45.888		48.48	V	100	0	-13.96	-----	34.52	-----	40.5	-----	5.9

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

AV = Average Measurement or Limit (>1GHz)

Notes:

4.2 Conducted Emissions

4.2.1 Test Justification

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

A limited scope of work was performed for the gap analysis testing, and conducted emissions was not applicable. The test data can be found in ACS report number 16-0527.C09.3A.

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	KES4021A	ESD Gun	SA003046	5/12/2017	5/12/2018

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 301 489-19 V2.1.0 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

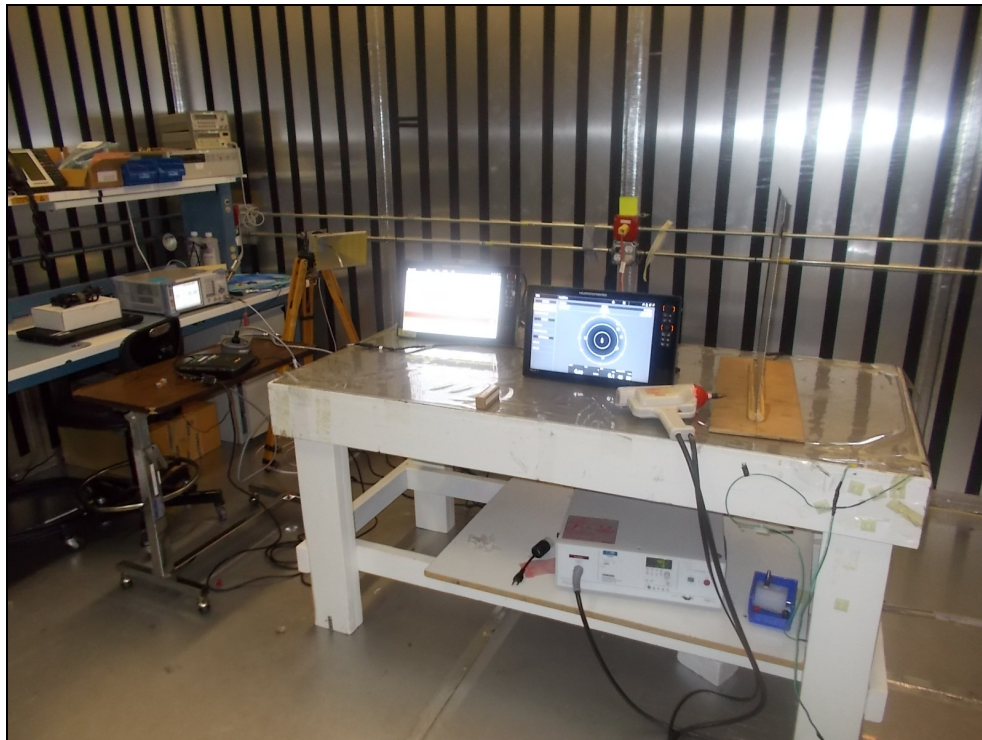
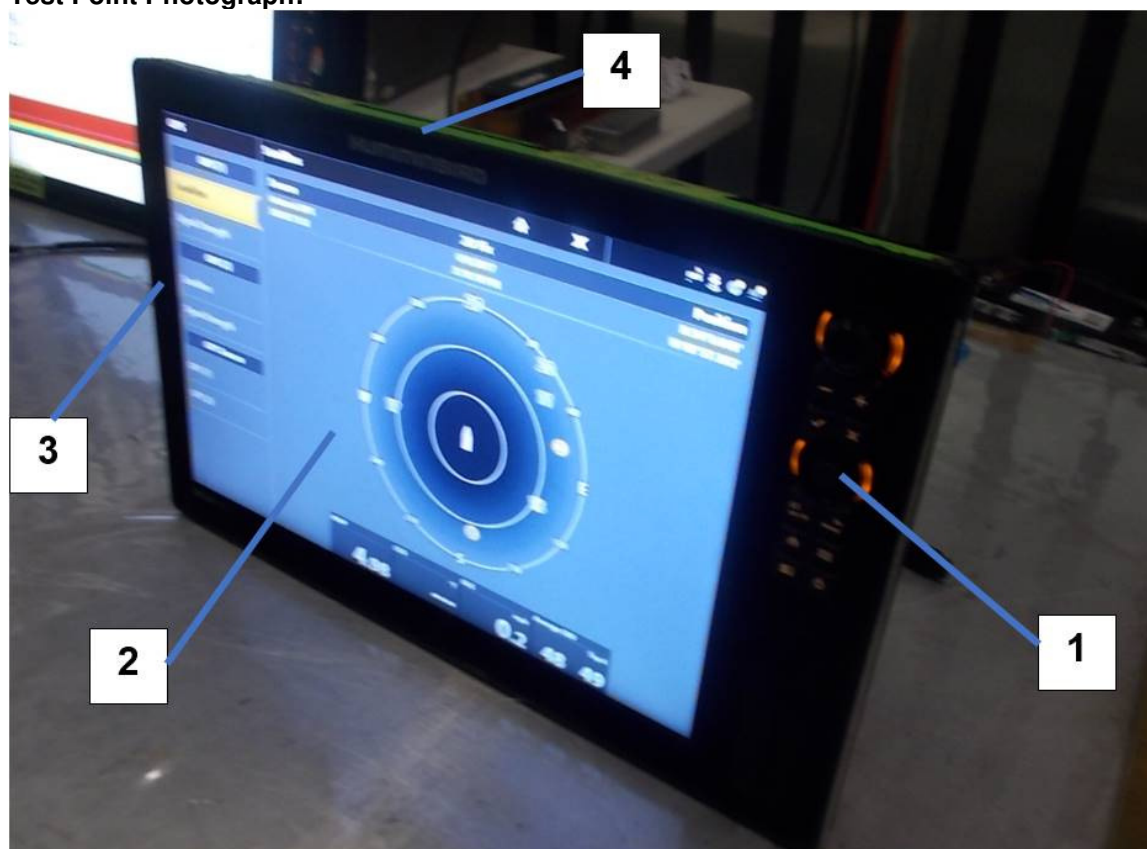
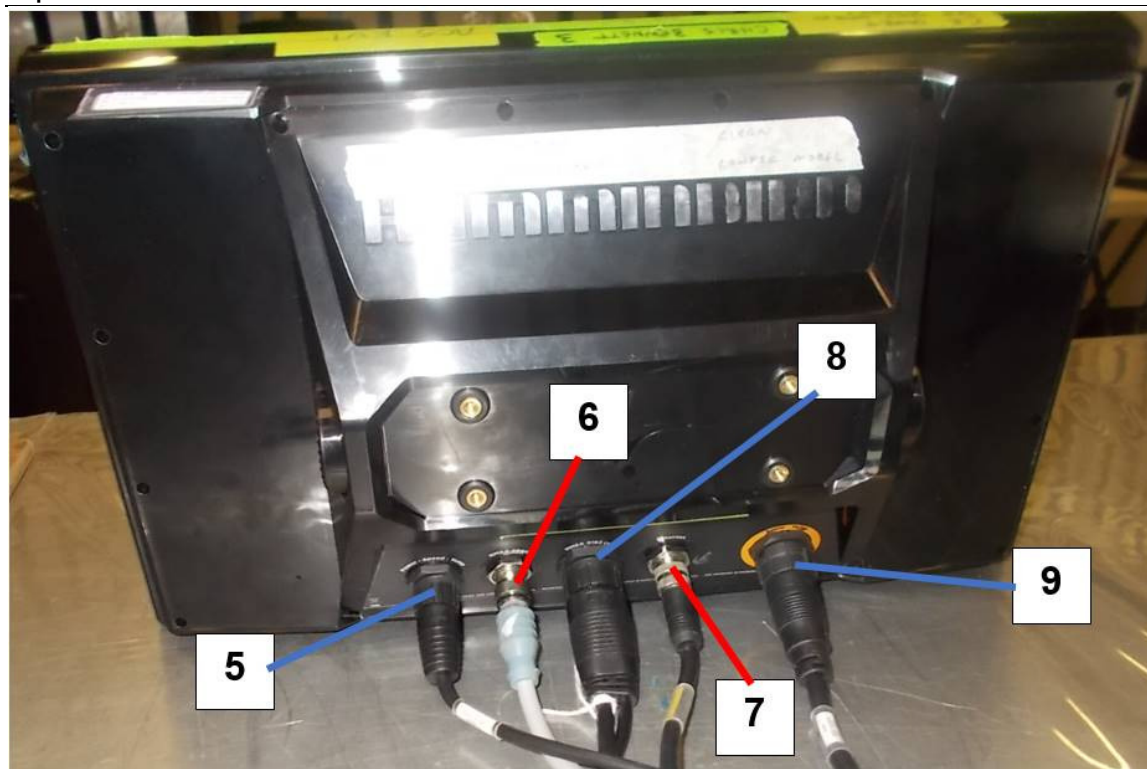


Figure 7.4-1: Test Setup Photograph

7.5 ESD Data Sheet

Test Point Photograph:





Test Point Selection:

TEST POINT#	DESCRIPTION	TYPE (C/A)
1	Control buttons / Power button	Air
2	LCD screen	Air
3	Seam on casing	Air
4	Seam on casing	Air
5	Rear connector	Air
6	Rear connector	Contact
7	Rear connector	Contact
8	Rear connector	Air
9	Rear connector	Air



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7.6 Test Data

Test Parameters:

Test Date:	6/12/17	Temperature (°C)	27
Technician:	Art Sumner	Humidity (%)	36
Equipment Class:	N/A	Barometric Pressure (mBar)	1015
		<input checked="" type="checkbox"/> Pre-test Verification Complete	
Tested Modes:	Powered ON, tracking satellites from simulator		
AC Input Power:	N/A	VCP Resistor Value Check:	958K Ohms
DC Input Power:	12Vdc	HCP Resistor Value Check:	959K Ohms

Indirect Contact Discharge:

Check All That Apply to This Data		
Plane:	Polarity:	Tested Levels:
<input type="checkbox"/> Vertical Coupling Plane	<input type="checkbox"/> Positive	<input checked="" type="checkbox"/> 2kV <input type="checkbox"/> 8kV
<input type="checkbox"/> Horizontal Coupling Plane	<input type="checkbox"/> Negative	<input checked="" type="checkbox"/> 4kV <input type="checkbox"/> 15kV
<input checked="" type="checkbox"/> Both	<input checked="" type="checkbox"/> Both	<input type="checkbox"/> 6kV <input type="checkbox"/> 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:		
<input type="checkbox"/> Positive	<input checked="" type="checkbox"/> 2kV	<input checked="" type="checkbox"/> 8kV	
<input type="checkbox"/> Negative	<input checked="" type="checkbox"/> 4kV	<input type="checkbox"/> 15kV	
<input checked="" type="checkbox"/> Both	<input type="checkbox"/> 6kV	<input type="checkbox"/> 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	Contact	Pass	
7	Contact	Pass	
8	Air	Pass	
9	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
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	12/9/2016	12/9/2017

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
684	Rohde & Schwarz	SML03	Signal Generators	103503	8/19/2016	8/19/2017
1112	Wandel & Goltermann	BN2244/21	Probes	H0006	12/9/2016	12/9/2017
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	12/9/2016	12/9/2017

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 301 489-19 V2.1.0 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

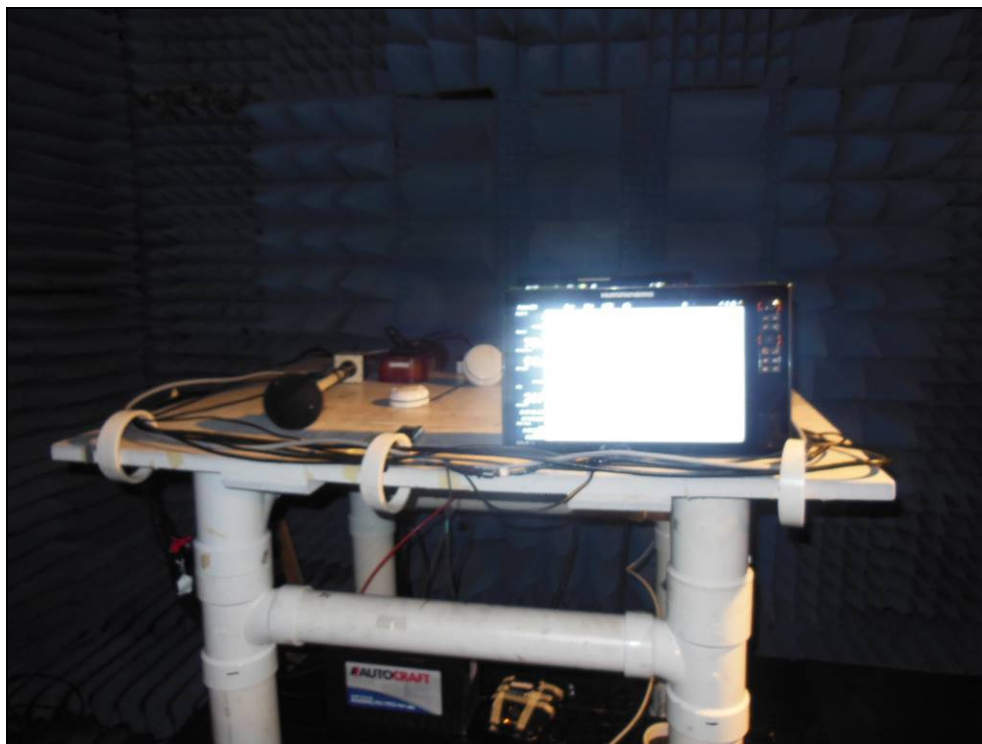


Figure 8.4-1: Test Setup Photograph



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8.5 Test Results

Test Parameters:

Test Date:	June 5, 2017	Temperature (°C)	23.1
Technician:	Sean Vick	Humidity (%)	39.4
Equipment Class:	N/A	Barometric Pressure (mBar)	1009.6
Tested Modes:	EUT on; Monitoring BT; GPS and overall functionality		
AC Input Power:	N/A	<input checked="" type="checkbox"/> Pre-test Verification Complete	
DC Input Power:	12Vdc		

Test Data:

Check All That Apply to This Data		
Polarity	Field Strength:	Freq. Band:
<input type="checkbox"/> Horizontal	<input checked="" type="checkbox"/> 3V/m	<input type="checkbox"/> 80-1000MHz
<input type="checkbox"/> Vertical	<input type="checkbox"/> 10V/m	<input type="checkbox"/> 80-2700MHz
<input checked="" type="checkbox"/> Both	<input type="checkbox"/> 8V/m	<input checked="" type="checkbox"/> 80MHz - 6GHz
	<input type="checkbox"/> Enter Other Level Here	

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

Notes:

Completed spot freq's

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
248	Keytek	EMC PRO	EMC Tester	9803353	12/16/2016	12/16/2017
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 301 489-19 V2.1.0 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

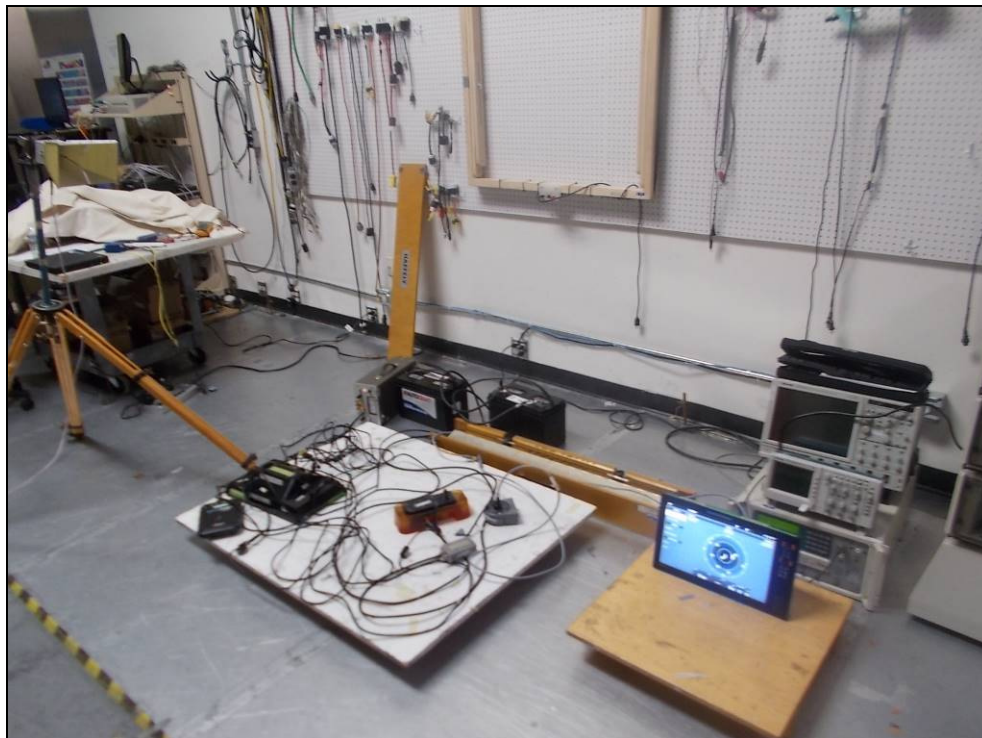


Figure 9.4-1: Test Setup Photograph

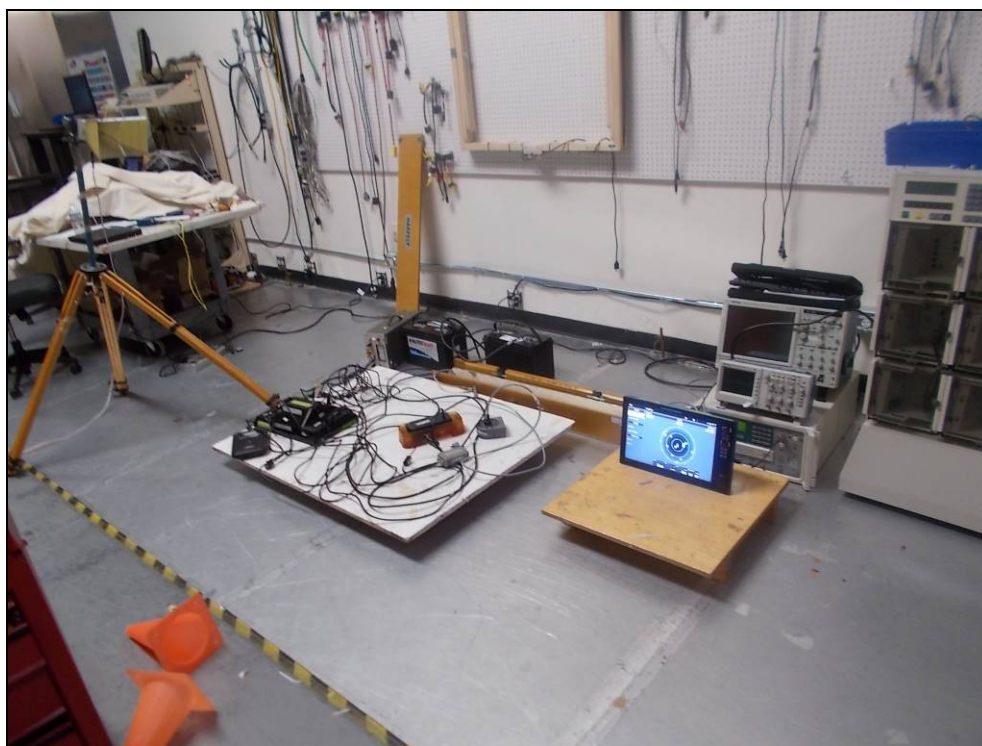


Figure 9.4-2: Test Setup Photograph



Model: SOLIX 15 SI (410420-1)
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9.5 Test Results

Test Parameters:

Test Date:	6/9/2017	Temperature (°C)	23.1
Technician:	Art Sumner	Humidity (%)	39.4
Equipment Class:	N/A	Barometric Pressure (mBar)	1009.6
Tested Modes:	GPS tracking satellites from simulator		
AC Input Power:	N/A	<input checked="" type="checkbox"/> Pre-test Verification Complete	
DC Input Power:	12Vdc		

Mains Test Data:

Check All That Apply to This Data		
Polarity: <input type="checkbox"/> Positive <input type="checkbox"/> Negative <input checked="" type="checkbox"/> Both	Tested Levels: <input checked="" type="checkbox"/> .5kV <input type="checkbox"/> 1kV <input type="checkbox"/> 2kV <input type="checkbox"/>	Interface Type: <input checked="" type="checkbox"/> Input <input type="checkbox"/> Output <input type="checkbox"/> Both
Coupling Mode	Result	Observation (Describe any detectable event)
Clamp	Pass	DC Mains

Notes:

Signal Line Test Data:

Check All That Apply to This Data		
Polarity: <input type="checkbox"/> Positive <input type="checkbox"/> Negative <input checked="" type="checkbox"/> Both	Tested Levels: <input checked="" type="checkbox"/> .25kV <input checked="" type="checkbox"/> .5kV <input type="checkbox"/> 1kV <input type="checkbox"/> 2kV <input type="checkbox"/> Enter Other Level Here	
Signal Line	Result	Observation (Describe any detectable event)
Ethernet	Pass	
Sonar	Pass	
NEMA 2000	Pass	
NEMA 0183	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	4/10/2017	4/10/2018
364	Amplifier Research	DC2600A	Coupler	0322466	NCR	NCR
370	IFI	CMX5002	Amplifier	L364-0407	NCR	NCR
418	Teseq	ISN-S501	LISN	24543	3/27/2017	3/27/2018
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	5/10/2017	5/10/2018
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 1.5×10^{-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 301 489-19 V2.1.0 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

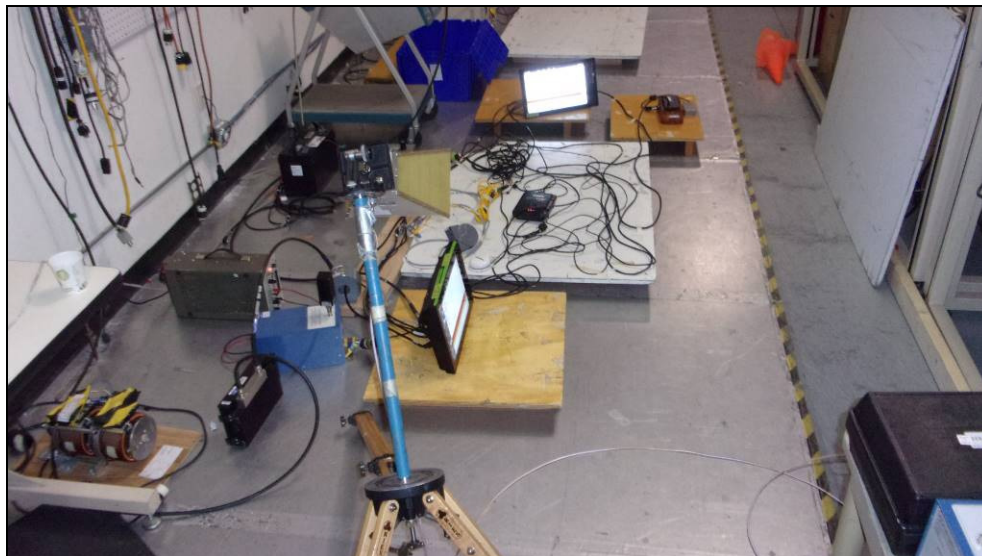


Figure 11.4-1: Test Setup Photograph

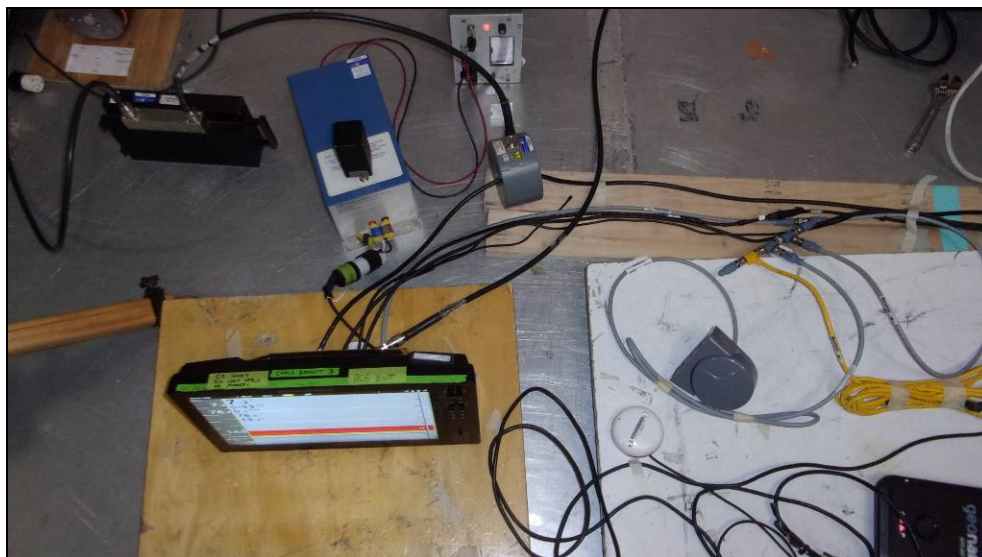


Figure 11.4-2: Test Setup Photograph



Model: SOLIX 15 SI (410420-1)
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11.5 Test Results

Test Parameters:

Test Date:	6/7/2017	Temperature (°C)	22
Technician:	Art Sumner	Humidity (%)	39
Equipment Class:	N/A	Barometric Pressure (mBar)	1011
Tested Modes:	Monitoring Depth, internal 3D fix on GPS generator		
AC Input Power:	N/A		
DC Input Power:	12Vdc		

Mains Test Data:

Check All That Apply to This Data		
Test Level:	Freq. Band:	
<input checked="" type="checkbox"/> 3Vrms	<input checked="" type="checkbox"/> .150-80MHz	
<input type="checkbox"/> 10Vrms	<input type="checkbox"/> Enter Other Band Here	
<input type="checkbox"/> 15Vrms		
<input type="checkbox"/> Enter Other Level 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:	Freq. Band:	
<input checked="" type="checkbox"/> 3Vrms	<input checked="" type="checkbox"/> .150-80MHz	
<input type="checkbox"/> 10Vrms	<input type="checkbox"/> Enter Other Band Here	
<input type="checkbox"/> 15Vrms		
<input type="checkbox"/> Enter Other Level Here		

Signal Line	Result	Observation (Describe any detectable event)
Network	Pass	
GPS puck	Pass	
Transducer cable	Pass	
Temperature sensor	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.