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TÜV SÜD America

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EMS Technical Report

Prepared For: Johnson Outdoors, INC

Model Covered: SOLIX 10 SI
Model Variants: SOLIX 10

In Accordance with the Conformity Assessment Procedure for Electromagnetic Interference (RRA Announce 2016-79, Dec 19, 2016)

EMS Product Standard: Annex 14 (KN 60945)

Report Number: AT72132224.7K3
Report Revision: D
Report Issue Date: February 14, 2018

This report contains Page 36 pages

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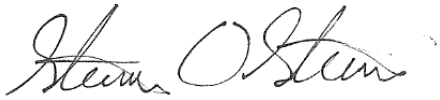
Reviewed by:



Steve O'Steen
Service Line Manager, EMC
TÜV SÜD America Inc.

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

REVISION HISTORY Report Number: AT72132224.7K3 Manufacturer: Johnson Outdoors, INC Model: SOLIX 10 SI					
DATE	OLD REVISION	NEW REVISION	REASON	PAGES AFFECTED	APPROVED BY
January 2, 2018	---	A	Initial Release	All	Steve O'Steen
January 5, 2018	A	B	Added KC ID and Product Type and revised model names	All	Steve O'Steen
January 19, 2018	B	C	Removed KC ID	1, header	Steve O'Steen
February 14, 2018	C	D	Added Panasonic Module information	4	Steve O'Steen

Project Information Sheet

Applicant Details

Manufacturer: Johnson Outdoors, INC
Street Address: 1220 Old Alpharetta Rd, Ste 340
City, State/Province and Postal Code: Alpharetta, GA 30005
Country: USA
Contact: Nancy Rimedio

Phone: 770-888-6292 (1049)
Fax:
Email: nrimedio@johnsonoutdoors.com

Sample Information

Model: SOLIX 10 SI
Model Variant(s): SOLIX 10 SI
Environment of Use: Residential
Sample Receive Date: October 30, 2017
Sample Receive Condition: Good
Test Mode Description: EUT on; Internal and External Antenna; External GPS connected; BT Connected; Accessories under floor
Unacceptable Degradation (Provided by Mfg.): Not Provided, See Section 1.4.1
Highest Data Rate: 1GHz
Source: Main Internal Processor

Product Description

The Humminbird SOLIX Series is a Sonar/Fishfinder/GPS product to be used in the marine environment. The SOLIX 10 has a 10" display with a PCAP touchscreen, 10 keypad buttons, encoder and joystick, 2 SD card slots and displays sonar return information on the display. The differences between the SOLIX 10 and the SOLIX 10 SI are as follows:

- SOLIX 10 - 10" display, pcap touchscreen, 2D sonar, internal GPS, NMEA 2K, bluetooth (BLE and Classic)
- SOLIX 10 SI (EUT) - 10" display, pcap touchscreen, 2D, down imaging and side imaging sonar, internal GPS, NMEA 2K, bluetooth (BLE and Classic)

Panasonic Module model name ENW89823A3KF, Report No MOV-16-RF-K134, KC approval No MSIP-CRM-Pid-ENW89823A3KF.

Test Information

Test Start Date: October 30, 2017
Test End Date: November 15, 2017
EMI Freq. Band: 150kHz - 2GHz
RFI Site: FAC
Radiated Emissions Equipment Class: Class B

Test Methods Applied

(Check all that apply)

☒ Annex 1-13 (KN 61000-4-2)
☒ Annex 1-14 (KN 61000-4-3)
☒ Annex 1-15 (KN 61000-4-4)
☐ Annex 1-16 (KN 61000-4-5)
☒ Annex 1-17 (KN 61000-4-6)
☐ Annex 1-18 (KN 61000-4-8)
☐ Annex 1-19 (KN 61000-4-11)

Table of Contents

SECTION A: GENERAL INFORMATION

1.0 Introduction

1.1 Scope

This report documents conformance with the requirements set forth in Annex 14 (KN60945) in accordance with the Conformity Assessment Procedure for Electromagnetic Interference (RRA Announce 2016-79) and details the results of testing performed on October 30, 2017 through November 15, 2017 on the model SOLIX 10 SI manufactured by Johnson Outdoors, INC.

1.2 Purpose

Testing was performed to evaluate the EUT with regard to EMC regulatory requirements in accordance with the Conformity Assessment Procedures for Electromagnetic Interference (RRA Announce 2016-79) arrangements.

1.3 Results Summary

Product Standard or Test Method Applied	Description	Result
	Immunity Standards per Annex 14 (KN60945)	
Annex 1-13 (KN 61000-4-2)	Electromagnetic compatibility (EMC) - Part 4-2: Testing and measurement techniques - Electrostatic discharge immunity test	Pass
Annex 1-14 (KN 61000-4-3)	Electromagnetic compatibility (EMC) - Part 4-3: Testing and measurement techniques - Radiated, radio-frequency, electromagnetic field immunity test	Pass
Annex 1-15 (KN 61000-4-4)	Electromagnetic compatibility (EMC) - Part 4-4: Testing and measurement techniques - Electrical fast transient/burst immunity test	Pass
Annex 1-16 (KN 61000-4-5)	Electromagnetic compatibility (EMC) - Part 4-5: Testing and measurement techniques - Surge immunity test	N/A
Annex 1-17 (KN 61000-4-6)	Electromagnetic compatibility (EMC) - Part 4-6: Testing and measurement techniques - Immunity to conducted disturbances, induced by radio-frequency fields	Pass
Annex 1-18 (KN 61000-4-8)	Electromagnetic compatibility (EMC) - Part 4-8: Testing and measurement techniques - Power frequency magnetic field immunity test	N/A
Annex 1-19 (KN 61000-4-11)	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 Immunity Performance Criteria

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

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

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

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

Manufacturers Performance Criterion: See Sample Information on page 3 of this report.

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

As part of the APEC Tel MRA, TÜV SÜD America Inc. has been assigned US Identification Number US0156 by the US National Institute of Standards and Technology (NIST).

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

2.3 Test Environment

Unless otherwise specified by the generic or product standard, the EUT was evaluated within the climate conditions of the EUT as specified by the manufacturer.

Where the manufacturer does not specify climate parameters for the EUT, all test are performed within the climate parameters given below:

- Ambient temperature 15° to 35° C
- Relative Humidity 30% to 60%
- Atmospheric Pressure 860mbar to 1060mbar

2.4 Test Equipment Calibration Statement

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

3.0 Equipment Under Test (EUT)

3.1 Manufacturer

Johnson Outdoors, INC
1220 Old Alpharetta Rd, Ste 340
Alpharetta, GA 30005
Nancy Rimedio
770-888-6292 (1049)
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

☒ **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

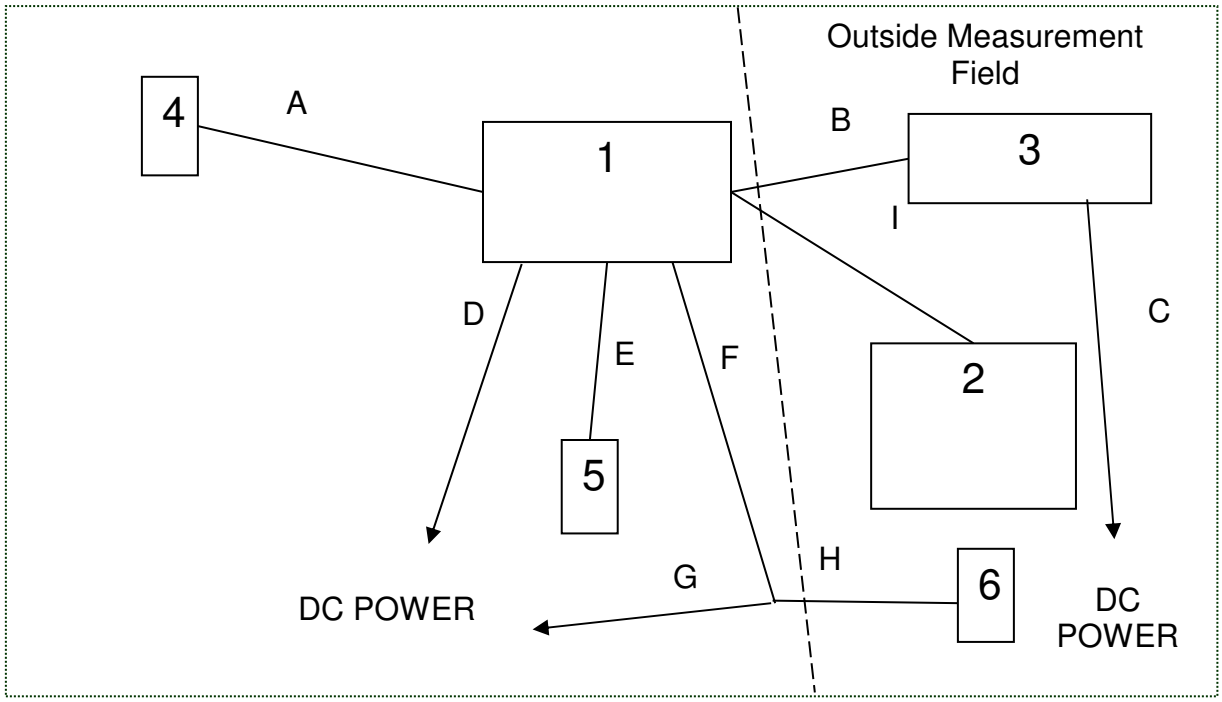


Figure 3.3-1: System Block Diagram

Table 3.3-1: EUT and Support Equipment Description

Item #	Type Device	Manufacturer	Model/Part #	Serial #
1	EUT	Johnson Outdoors	Solix 10 SI	N/A
2	Auxiliary Equipment	Johnson Outdoors	Solix 10 SI	N/A
3	GEO NAV	Techsonic Industries	GTX AIS	46090073
4	GPS antenna	Humminbird	AS*GPS HS	12071842-0039
5	Transducer	Johnson Outdoors	N/A	N/A
6	NMEA2000 antenna	Maretron	N/A	N/A

Table 3.3-2: Cable Description

Cable #	Cable Type	Length	Shield	Termination
A	GPS	20’	No	1 - 4
B	Signal cable	25’	No	1 - 3
C	DC leads	4’	No	3 – DC power
D	DC leads	5’	No	1 – DC power
E	Transducer cable	20’	No	1 - 5
F	NMEA2000 cable	16’	No	1 - H
G	DC leads	6’	No	H – DC power
H	NMEA2000 cable	6’	No	F - 6
I	Ethernet	30’	No	1 - 2

3.4 Observations

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

Table 3.4-1: Observations

Observation No.	Description

3.5 EUT Photographs

Figure 3.5-1: EUT Photo – Front

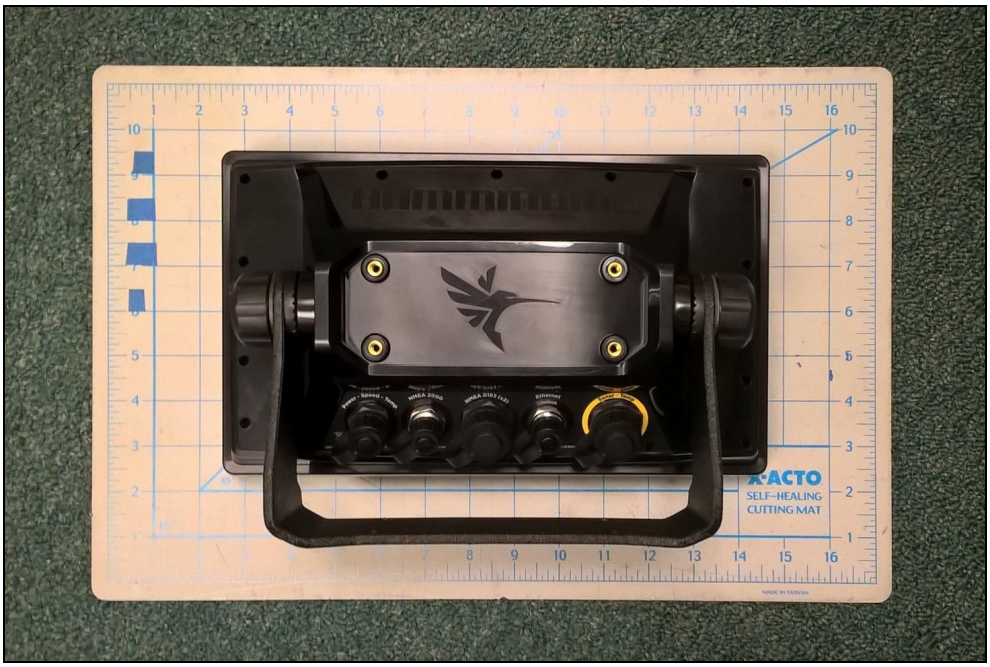


Figure 3.5-2: EUT Photo – Back

SECTION B: TEST INFORMATION AND RESULTS

4.0 Annex 1-13 (KN 61000-4-2) Electrostatic Discharge Immunity

4.1 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.

4.2 Test Equipment

Table 4.2-1: 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

4.3 Test Methodology

Annex 1-13 (KN 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.

4.3.1 Test Criteria

Annex 14 (KN60945) requires performance criterion B to be met as described in section 1.4.1.

4.3.2 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:**

4.4 Test Setup Photograph

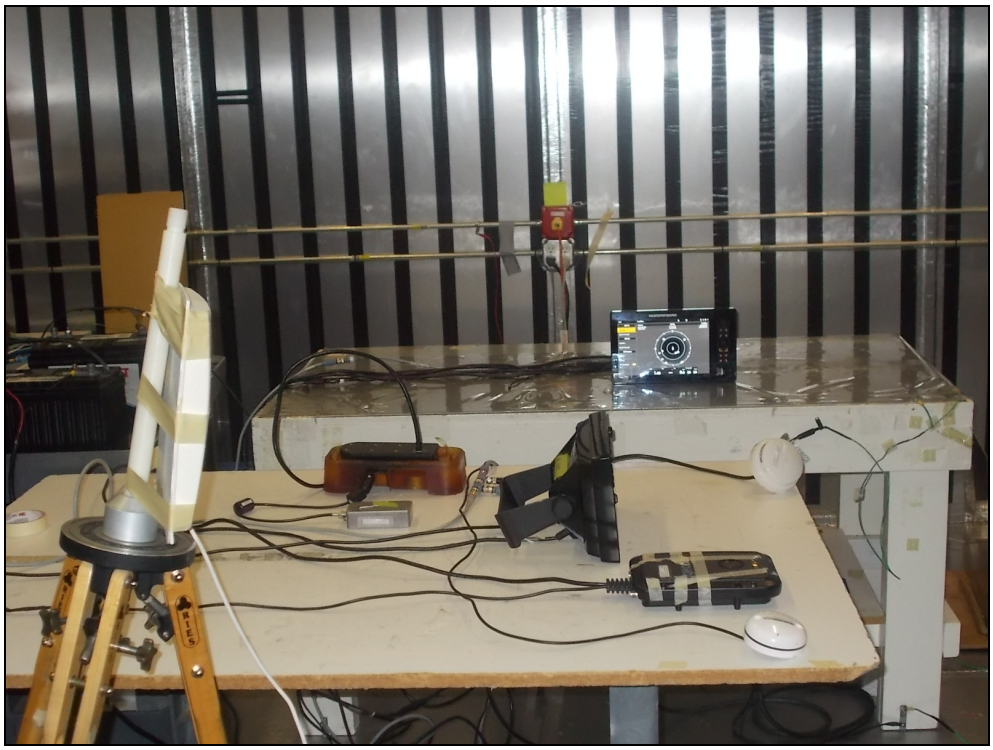
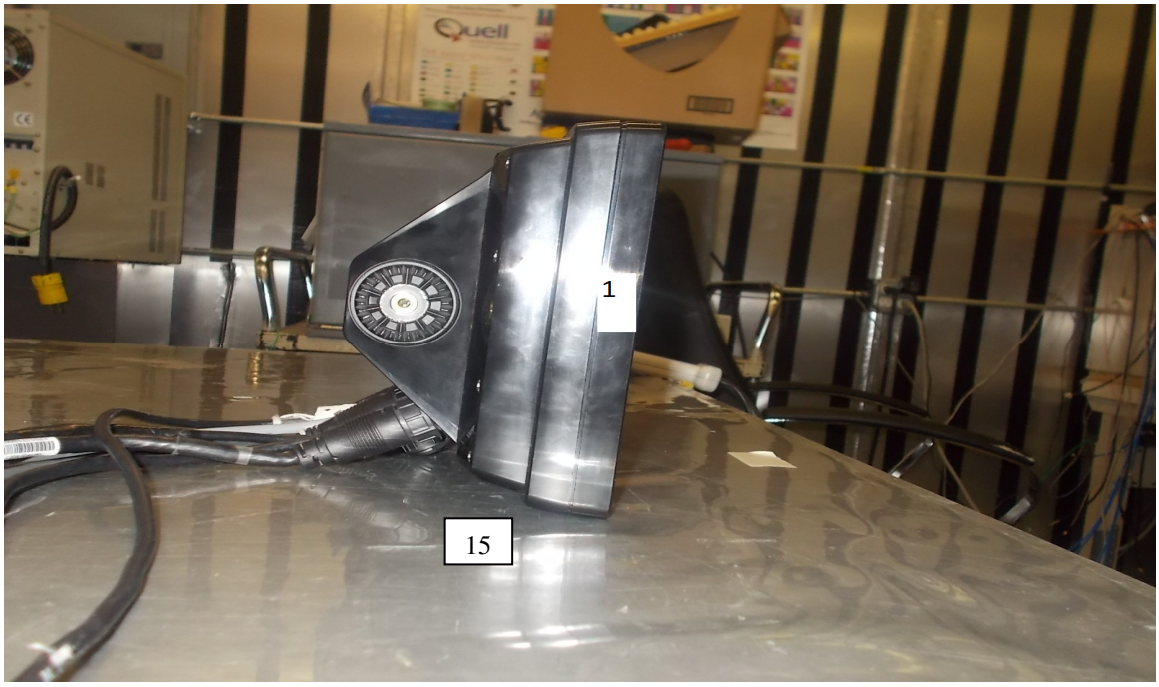


Figure 4.4-1: Test Setup Photograph

4.5 ESD Data Sheet

Test Point Photograph:




3
EUT


4
5
6
7
8

Test Point Selection:

TEST POINT#	DESCRIPTION	TYPE (C/A)	TEST POINT#	DESCRIPTION	TYPE (C/A)
1	Right side seam	**Air**	11	Top Screen Seam	**Air**
2	Left side seam	**Air**	12	Bottom Screen seam	**Air**
3	Top seam	**Air**	13	Left Screen seam	**Air**
4	Power Cable port	**Air**	14	Right Screen seam	**Air**
5	NMEA 2000 Port	**Contact**	15	Bottom Seam	**Air**
6	NMEA 0183 Port	**Air**			
7	Ethernet Port	**Contact**			
8	Sonar Temp Port	**Air**			
9	Twist Knob/Button Pad	**Air**			
10	Joystick/Button pad	**Air**			

4.6 Test Data

Test Parameters:

Test Date:	11/09/17	Temperature (ºC)	22.4
Technician:	Eugene Sello	Humidity (%)	40.2
Equipment Class:	N/A	Barometric Pressure (mBar)	1019.6
		☒ Pre-test Verification Complete	
Tested Modes:	Eut on, GPS and Bluetooth Connected and monitored		
AC Input Power:	N/A	VCP Resistor Value Check:	.976M (Ohms)
DC Input Power:	24VDC	HCP Resistor Value Check:	.985M (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	Contact	Pass	
6	Air	Pass	
7	Contact	Pass	
8	Air	Pass	
9	Air	Pass	
10	Air	Pass	
11	Air	Pass	
12	Air	Pass	

13	**Air**	**Pass**	
14	**Air**	**Pass**	
15	**Air**	**Pass**	

Notes:
Air discharge testing performed up to 8KV, contact discharge testing performed up to 6KV.

5.0 Annex 1-14 (KN 61000-4-3) Radio-Frequency Electromagnetic Fields

5.1 Test Site Description

The radiated fields test was performed in a fully-anechoic chamber.

5.2 Test Equipment

Table 5.2-1: 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	7/10/2017	7/10/2018
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	8/3/2017	8/3/2019
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	NCR	NCR
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	9/8/2017	9/8/2018
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	NCR	NCR
620	Teledyne Storm Microwave	90-195-456	Cables	13-10-602	NCR	NCR
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

5.3 Test Methodology

Annex 1-14 (KN 61000-4-3) - Electromagnetic compatibility (EMC) - Part 4. Testing and measurement techniques - Section 3: Radiated, radio-frequency, electromagnetic field immunity test, was the guiding document for this test. The purpose of this test is to verify the immunity of single devices or systems when subjected to radio-frequency electromagnetic field.

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

The frequency ranges to be considered are swept with the signal 80% amplitude modulated with a 400Hz 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.

5.3.1 Test Criteria

Annex 14 (KN60945) requires criterion A to be met as described in section 1.4.1.

5.3.2 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:**

5.4 Test Setup Photographs

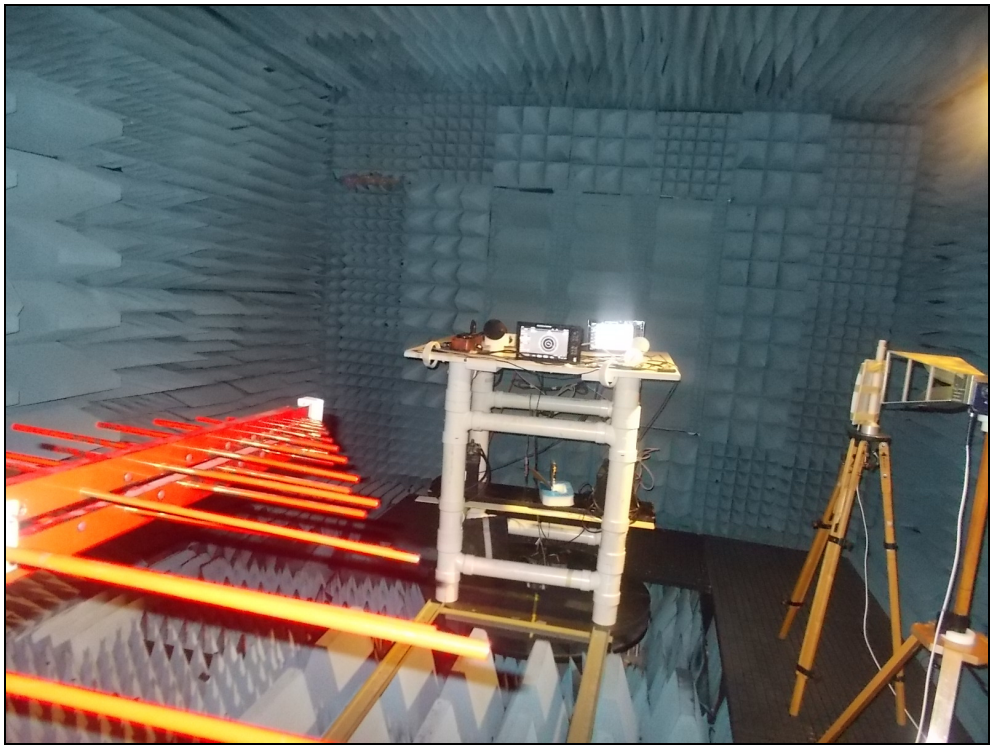


Figure 5.4-1: Test Setup Photograph

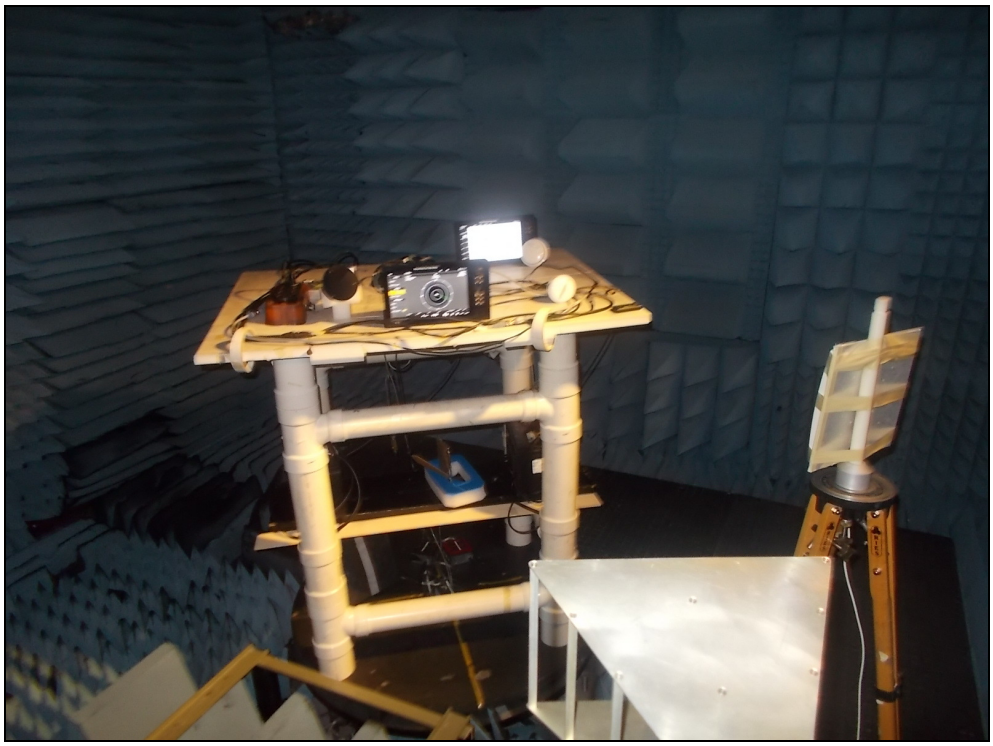


Figure 5.4-2: Test Setup Photograph

5.5 Test Results

Test Parameters:

Test Date:	**11/7/2017**	**Temperature (ºC)**	**23**
Technician:	**Art Sumner**	**Humidity (%)**	**41**
Equipment Class:	**N/A**	**Barometric Pressure (mBar)**	**1019**
Tested Modes:	**Monitoring GPS and Bluetooth**		
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	☒ 2.86 Seconds
☐ Vertical	☒ 10V/m	☐ 80-6000MHz	☐ 3 Seconds
☒ Both	☐ 8V/m	☐ Enter Other Band Here	☐ Enter Other
	☒ 400Hz A.M.		

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

Test Data:

Check All That Apply to This Data

Polarity	Field Strength:	Freq. Band:	Dwell Time
☐ Horizontal	☐ 3V/m	☐ 80-1000MHz	☐ 2.86 Seconds
☐ Vertical	☒ 10V/m	☒ 1000-2000MHz	☐ 3 Seconds
☒ Both	☐ 8V/m	☐ Enter Other Band Here	☒ 8.6 Seconds
	☒ 400Hz A.M.		

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

Notes:
Spot frequencies also tested.
Frequencies of key interest also tested:

Source/Device	Frequency	Notes
5V Buck Converter	3MHz	
3.3V Buck Converter	3MHz	
Boost Switcher	2MHz	Synced
Power Manager	3MHz	Need to verify
AM3874 Reference Clock	20MHz	
AM3874 Internal Clock	1000MHz	

DSP Reference Clock	25MHz	
DSP Internal Clock	400MHz	
Display Clock	~71-72 MHZ	
Display Backlight	1MHz	Synced
Keyboard Backlight		
Ethernet Reference Clock	25MHz	
Ethernet Clock	50MHz	
DDR3 Memory PWR Supply	400kHz	Not Fixed, Adaptive Need to verify
DDR3 Memory	400MHz	
STM32F4 Reference Clock	8MHz	
STM32F4 Internal Clock	72MHz	
NMEA0183 UART Clock	14.31818MHz	
External A/D Conv. (CHIRP)	???	
GPS TCXO	26MHz	
GPS Receiver (GPS/GALILEO)	1575.42MHz	
GPS Receiver (GLONASS)	1602MHz	
GPS Receiver (BeiDou)	1561.098MHz	
Bluetooth Radio	2400MHz	
External A/D Conv. (Temp)	99.6Khz	

6.0 Annex 1-15 (KN 61000-4-4) Electrical Fast Transient/Bursts

6.1 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.

6.2 Test Equipment

Table 6.2-1: Test Equipment List

AssetID	Manufacturer	Model#	Equipment Type	Serial#	Calibration Performed Date	Calibration Due Date
62	Haefely Trench	EFT Clamp	Immunity Equipment	N/A	7/12/2017	7/12/2018
494	Omega	iBTHX-W	Climate Monitoring Equipment	9460211	8/1/2016	8/1/2018
474	Keytek	EMC PRO	General Lab Equipment	9808246	3/13/2017	3/13/2018

NCR = No Calibration Required

6.3 Test Methodology

Annex 1-15 (KN 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.

6.3.1 Test Criteria

Annex 14 (KN60945) requires criterion B to be met as described in section 1.4.1.

6.3.2 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:**

6.4 Test Setup Photographs

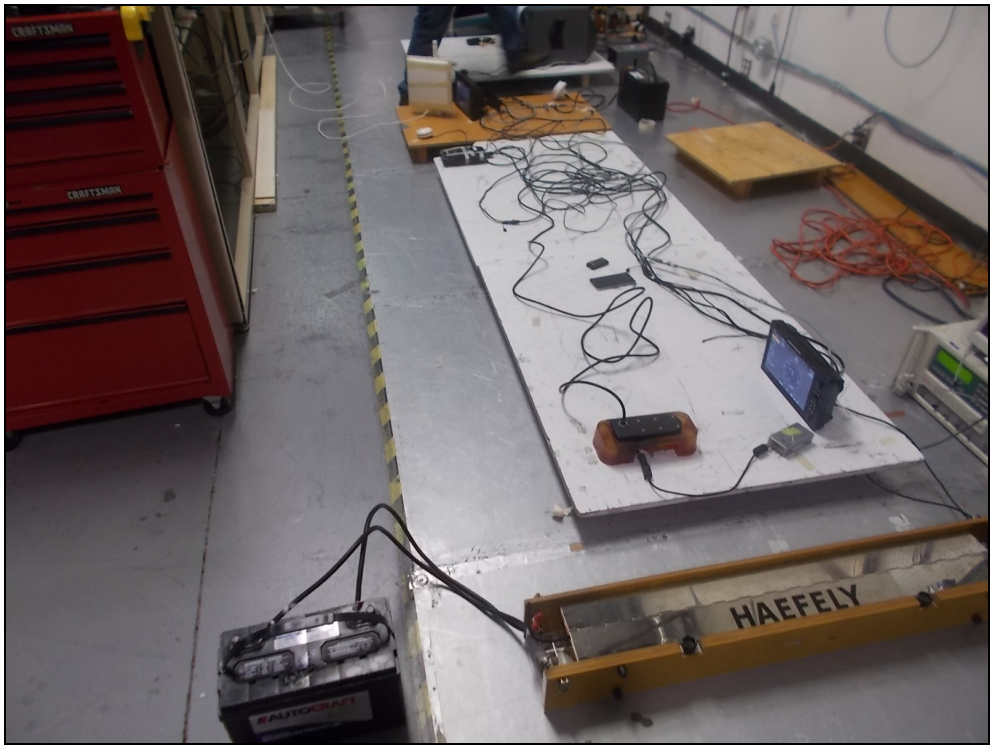


Figure 6.4-1: Test Setup Photograph

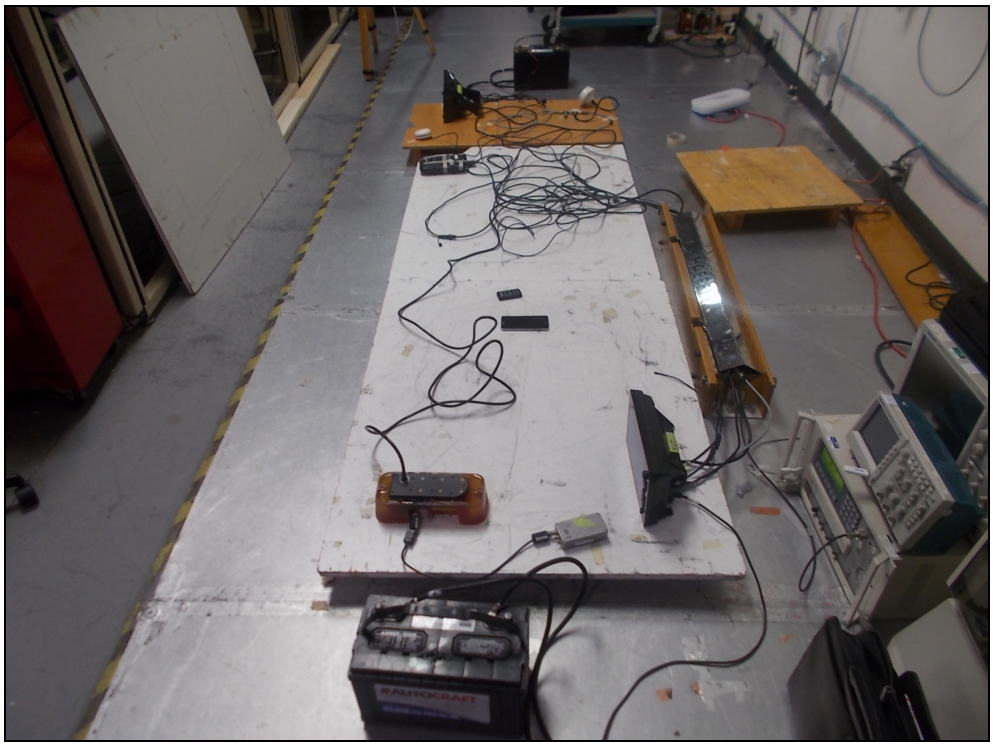


Figure 6.4-2: Test Setup Photograph

Figure 6.4-3: Test Setup Photograph

6.5 Test Results

Test Parameters:

Test Date:	**11/2/17**	**Temperature (ºC)**	**21**
Technician:	**Eugene Sello**	**Humidity (%)**	**40.3**
Equipment Class:	**N/A**	**Barometric Pressure (mBar)**	**1018.6**
Tested Modes:	**GPS/GLONASS/Bluetooth Connected and monitored**		
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)
Clamp	Pass	

Notes:
12VDC Battery Input Power tested through Clamp. 3 minute dwell time.

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)
NMEA 2000	Pass	
NMEA 0183	Pass	
Ethernet	Pass	
Sonar Temp	Pass	

Notes:
3 minute dwell time

7.0 Annex 1-16 (KN 61000-4-5) Surge Immunity

7.1 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:**

The EUT is DC powered; therefore, this test is not applicable and was not performed because the EUT is not directly connected to the AC power lines during operation.

8.0 Annex 1-17 (KN 61000-4-6) Radio-Frequency Common-Mode Immunity

8.1 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).

8.2 Test Equipment

Table 8.2-1: Test Equipment List

AssetID	Manufacturer	Model#	Equipment Type	Serial#	Calibration Performed Date	Calibration Due Date
5	Chase	CSP-8441	Probes	19	6/5/2017	6/5/2018
93	Chase	8101	Clamp	65	5/25/2017	5/25/2018
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	7/11/2017	7/11/2018
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	7/10/2017	7/10/2018

NCR = No Calibration Required

8.3 Test Methodology

Annex 1-17 (KN 61000-4-6) - 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 400Hz 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.

8.3.1 Test Criteria

Annex 14 (KN60945) requires criterion A to be met as described in section 1.4.1.

8.3.2 Test Justification

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

8.4 Test Setup Photographs

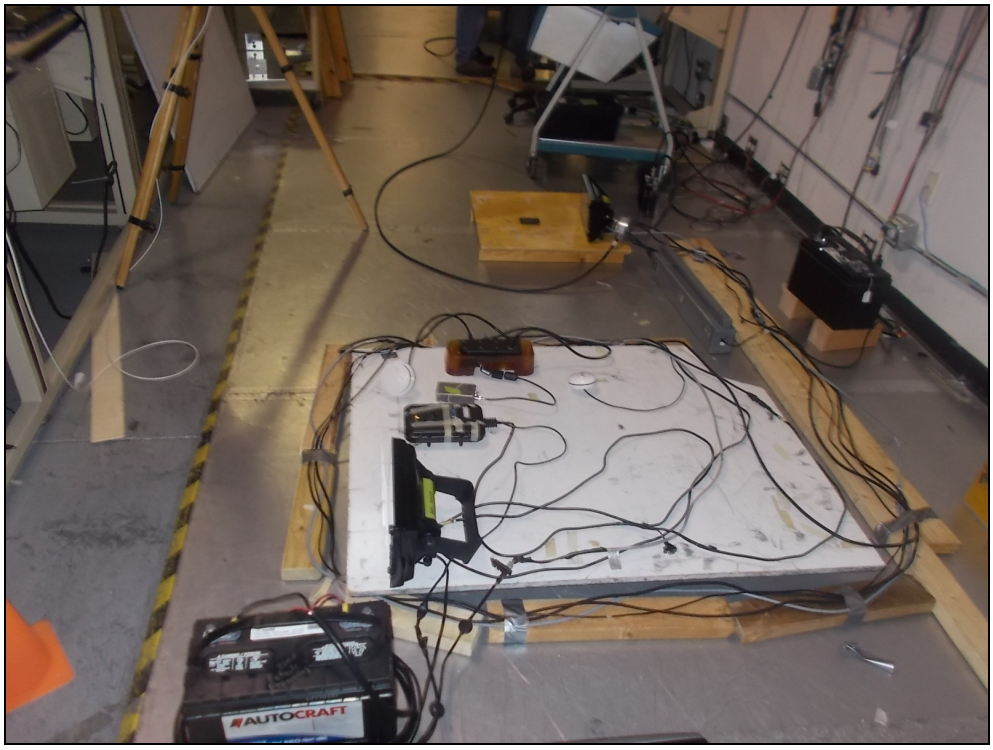


Figure 8.4-1: Test Setup Photograph

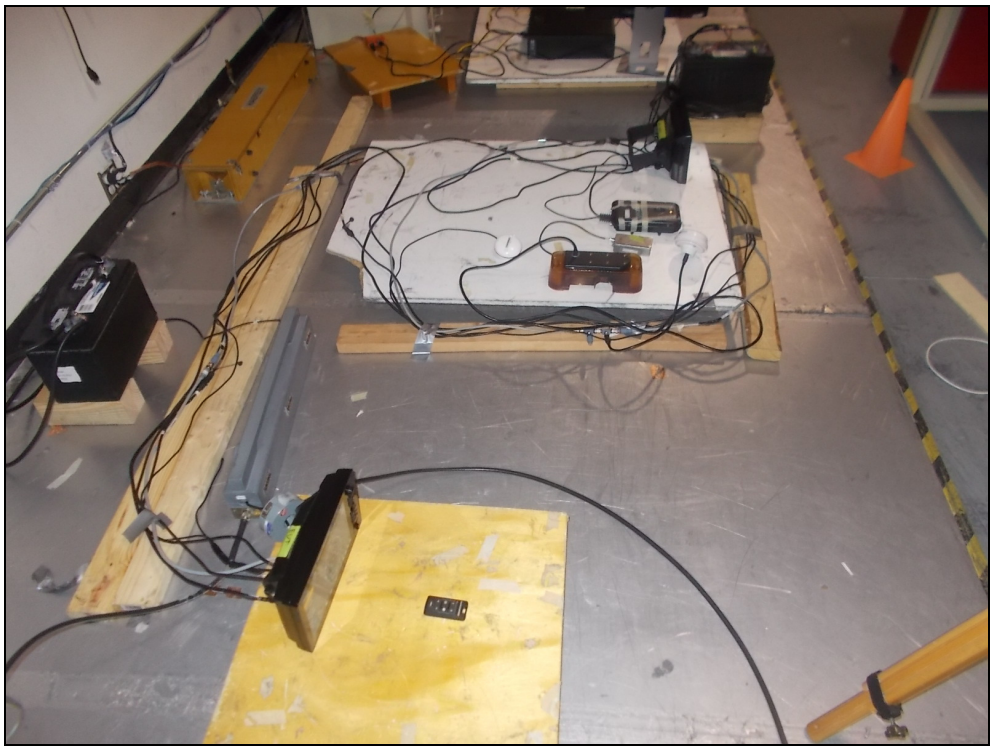


Figure 8.4-2: Test Setup Photograph

Figure 8.4-3: Test Setup Photograph

8.5 Test Results

Test Parameters:

Test Date:	**11/8/17**	**Temperature (ºC)**	**20.3**
Technician:	**Eugene Sello**	**Humidity (%)**	**40.1**
Equipment Class:	**N/A**	**Barometric Pressure (mBar)**	**1021**
Tested Modes:	**GPS/GLONASS, Bluetooth Connected and monitored**		
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)
Clamp	**Pass**	

Notes:
Spot frequency test at 10Vrms at 2.0, 3.0, 4.0, 6.2, 8.2, 12.6, 16.5, 18.8, 22 and 25 (MHz) for both DC input and Cables

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)
NMEA 2000	**Pass**	
NMEA 0183	**Pass**	
Ethernet	**Pass**	
Sonar Temp	**Pass**	

Notes:
Spot frequency test at 10Vrms at 2.0, 3.0, 4.0, 6.2, 8.2, 12.6, 16.5, 18.8, 22 and 25 (MHz) for both DC input and Cables

9.0 Annex 1-18 (KN 61000-4-8) Power Frequency Magnetic Fields Immunity

9.1 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 required per EN 301 489; therefore, it was not performed.

10.0 Annex 1-19 (KN 61000-4-11) Voltage Dips and Interruptions

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:**

The EUT is DC powered; therefore, this test is not applicable and was not performed because the EUT is not directly connected to the AC power lines during operation.

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.