

EMS Technical Report

Prepared For: Johnson Outdoors Marine Electronics, Inc.

Base Model: HELIX 7 CHIRP SI GPS G2
Models Tested: HELIX 7X CHIRP DI G2, HELIX 7X CHIRP GPS G2,
HELIX 7X CHIRP DI GPS G2

Product Type: Sonar Fish Finder
Product Category: Information Technology Equipment

KC ID: MSIP-REM-Jom-H7G2

In Accordance with the:
Conformity Assessment Procedure for Electromagnetic Interference
(RRA Announce 2015-110, Dec 3, 2015)

EMS Product Standard: Annex 8-1 (KN 301 489-1), Annex 8-8 (KN 301 489-3)

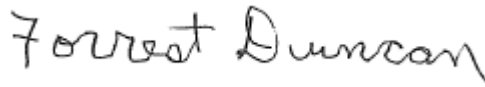
Report: 16-0277.C08.9B
Report Revision: B
Report Issue Date: November 11, 2016

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This report contains 28 pages

REVISION HISTORY
 Report Number: 16-0277.C08.9B
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 Model: HELIX 7 CHIRP SI GPS G2

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Project Information Sheet

ACS Project: 16-0277.C08.9B

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: Seth Bergman

Phone: 334-687-6613

Fax:

Email: sbergman@johnsonoutdoors.com

Sample Information

Model: HELIX 7 CHIRP SI GPS G2 (410310-1M)

Model Variant(s): HELIX 7X CHIRP DI G2, HELIX 7X CHIRP GPS G2, HELIX 7X CHIRP DI GPS G2

Environment of Use: Residential

Sample Receive Date: June 20, 2016

Sample Receive Condition: Good

Test Mode Description: Battery Powered; GPS Active; Sonar mode measuring 6ft

Unacceptable Degradation (Provided by Mfg.): The Depth reading should stay with +/- 1ft. The manufacturer declares an exclusion band in the range 195kHz to 205kHz range since the device is tuned to and designed to operate at 200kHz during normal operation.

Highest Data Rate: 1.575GHz

Source: GPS Receiver

Product Description

The Humminbird Helix 7 Gen 2 is a Sonar/Fishfinder product to be used in the marine environment. Product has a 7" display, 10 keypad buttons and displays Sonar return information on the screen. The device is mounted on the main deck/consoles of small recreational vessels in an exposed environment (directly exposed to the weather).

The model variants are defined as follows, per the manufacturer:

- HELIX 7X CHIRP DI G2 (410280-1M)
- HELIX 7X CHIRP GPS G2 (410290-1M)
- HELIX 7X CHIRP DI GPS G2 (410300-1M)

Test Information

Test Start Date: June 20, 2016

Test End Date: June 24, 2016

Emissions Pre-scan Site: SAC

Final Emissions Site: OATS

EMI Freq. Band: 150kHz - 6GHz

RFI Site: FAC

Radiated Emissions Equipment

Class: Class B

Test Methods Applied

(Check all that apply)

- ☒ Annex 1-1 (KN 61000-4-2)
- ☒ Annex 1-2 (KN 61000-4-3)
- ☒ Annex 1-3 (KN 61000-4-4)
- ☐ Annex 1-4 (KN 61000-4-5)
- ☒ Annex 1-5 (KN 61000-4-6)
- ☐ Annex 1-6 (KN 61000-4-8)
- ☐ Annex 1-7 (KN 61000-4-11)

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SECTION A: GENERAL INFORMATION

1.0 Introduction

1.1 Scope

This report documents conformance with the requirements set forth in Annex 8-1 (KN 301 489-1) and Annex 8-8 (KN 301 489-3) in accordance with the Conformity Assessment Procedure for Electromagnetic Interference (RRA Announce 2015-110) and details the results of testing performed on June 20, 2016 through June 24, 2016 on the model HELIX 7 CHIRP SI GPS G2 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 Conformity Assessment Procedures for Electromagnetic Interference (RRA Announce 2015-110) arrangements.

1.3 Results Summary

Product Standard or Test Method Applied	Description	Result
<u>Immunity Standards per Annex 5 (KN24)</u>		
Annex 1-1 (KN 61000-4-2)	Electromagnetic compatibility (EMC) - Part 4-2: Testing and measurement techniques - Electrostatic discharge immunity test	Pass
Annex 1-2 (KN 61000-4-3)	Electromagnetic compatibility (EMC) - Part 4-3: Testing and measurement techniques - Radiated, radio-frequency, electromagnetic field immunity test	Pass
Annex 1-3 (KN 61000-4-4)	Electromagnetic compatibility (EMC) - Part 4-4: Testing and measurement techniques - Electrical fast transient/burst immunity test	Pass
Annex 1-4 (KN 61000-4-5)	Electromagnetic compatibility (EMC) - Part 4-5: Testing and measurement techniques - Surge immunity test	N/A
Annex 1-5 (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 1-6 (KN 61000-4-8)	Electromagnetic compatibility (EMC) - Part 4-8: Testing and measurement techniques - Power frequency magnetic field immunity test	N/A
Annex 1-7 (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:

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 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). ACS 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, ACS has been assigned US Identification Number US0156 by the US National Institute of Standards and Technology (NIST).

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

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
Seth Bergman
334-687-6613
sbergman@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

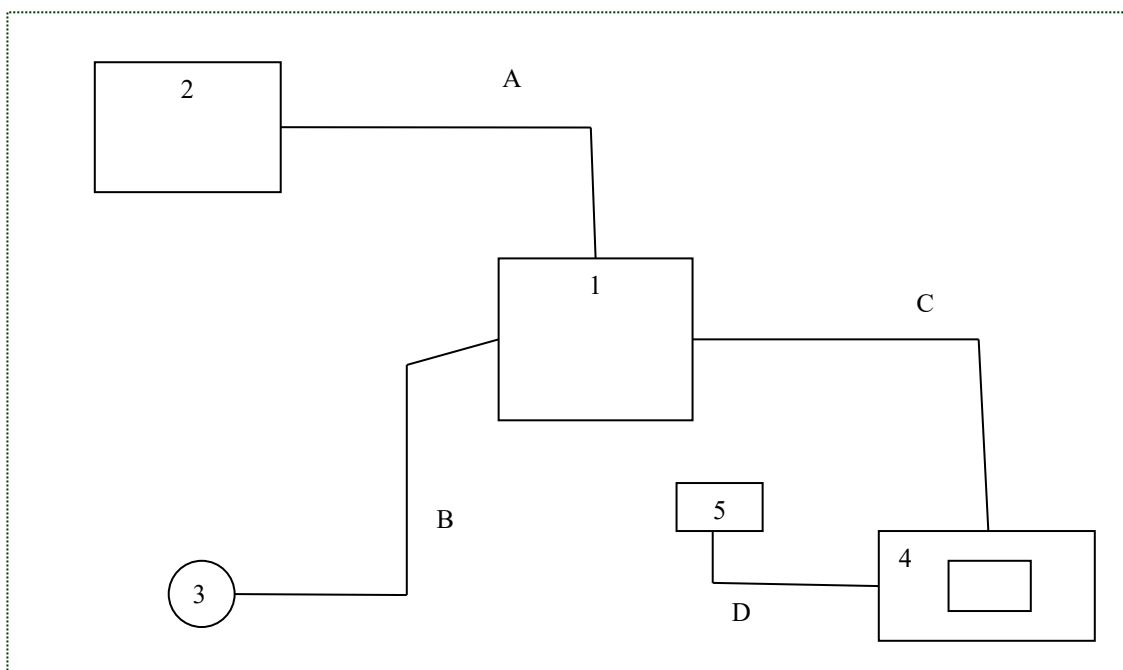


Figure 3.3-1: System Block Diagram

Table 3.3-1: EUT and Support Equipment Description

Item #	Type Device	Manufacturer	Model/Part #	Serial #
1	GPS Display	Humminbird	Helix 7 Gen. 2	N/A
2	12V Battery	AutoCraft	24DC-1	N/A
3	GPS Puck	Humminbird	N/A	12062742-0043
4	Transducer	Humminbird	N/A	N/A
5	Depth simulator	Humminbird	N/A	N/A

Table 3.3-2: Cable Description

Cable #	Cable Type	Length	Shield	Termination
A	Power Cable	100 cm	Not Shielded	1 - 2
B	GPS Cable	605 cm	Not Shielded	1 - 3
C	Transducer Cable	600 cm	Not Shielded	1 - 4
D	Coax Cable	35 cm	Not Shielded	4 - 5

3.4 Observations

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

Table 3.4-1: Observations

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

SECTION B: TEST INFORMATION AND RESULTS

4.0 Annex 1-1 (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 #	Last Calibration Date	Calibration Due Date
582	Kikusui	KES4021A	ESD Gun	SA003046	4/28/2016	4/28/2017

NCR = No Calibration Required

4.3 Test Methodology

Annex 1-1 (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 8-1 (KN 301 489-1) and Annex 8-8 (KN 301 489-3) 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

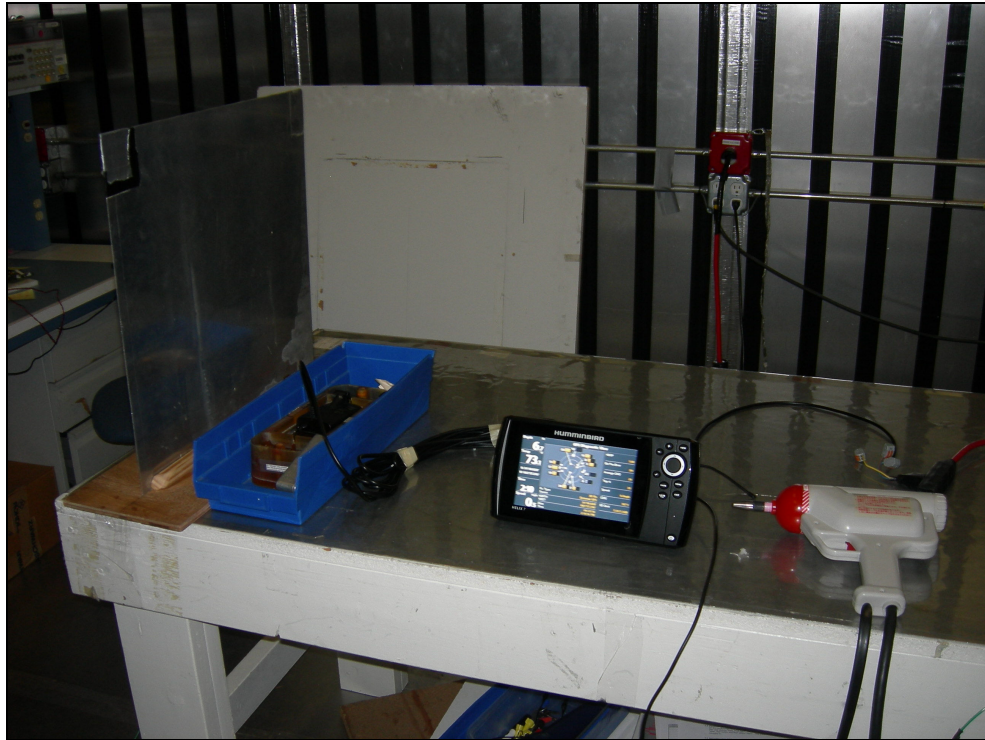
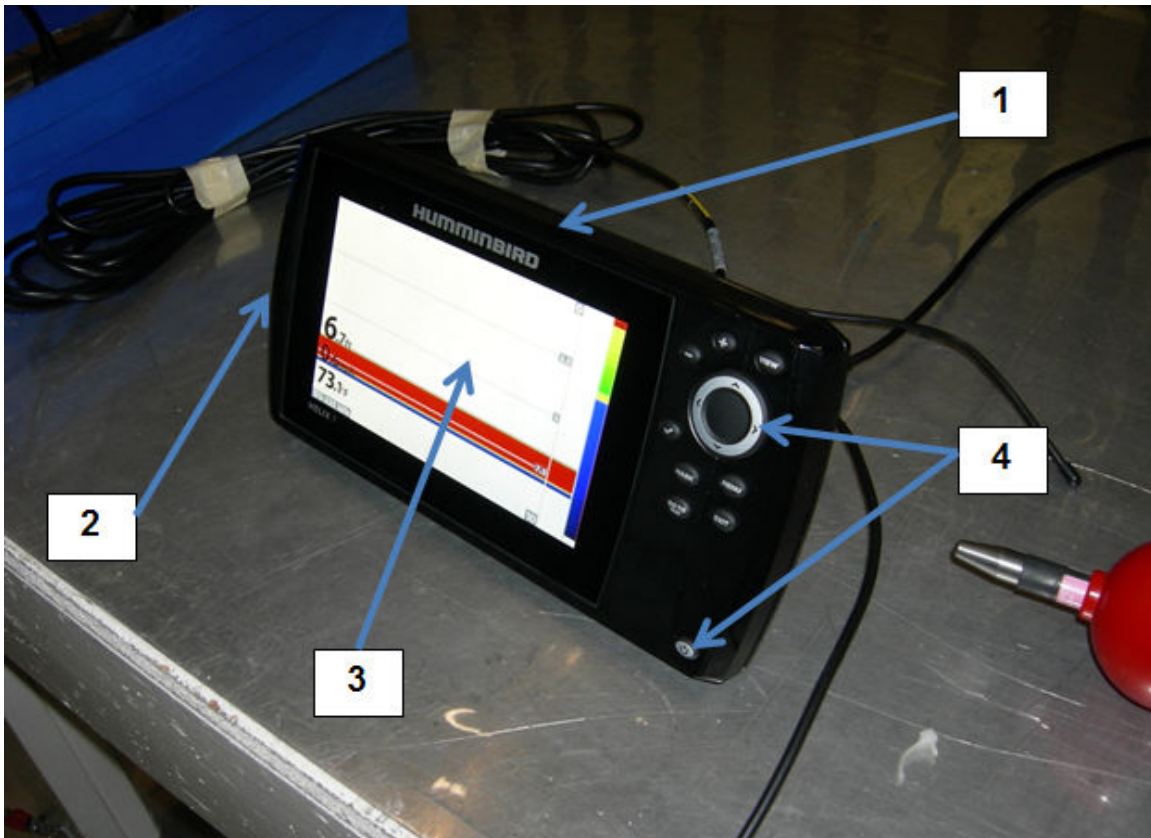
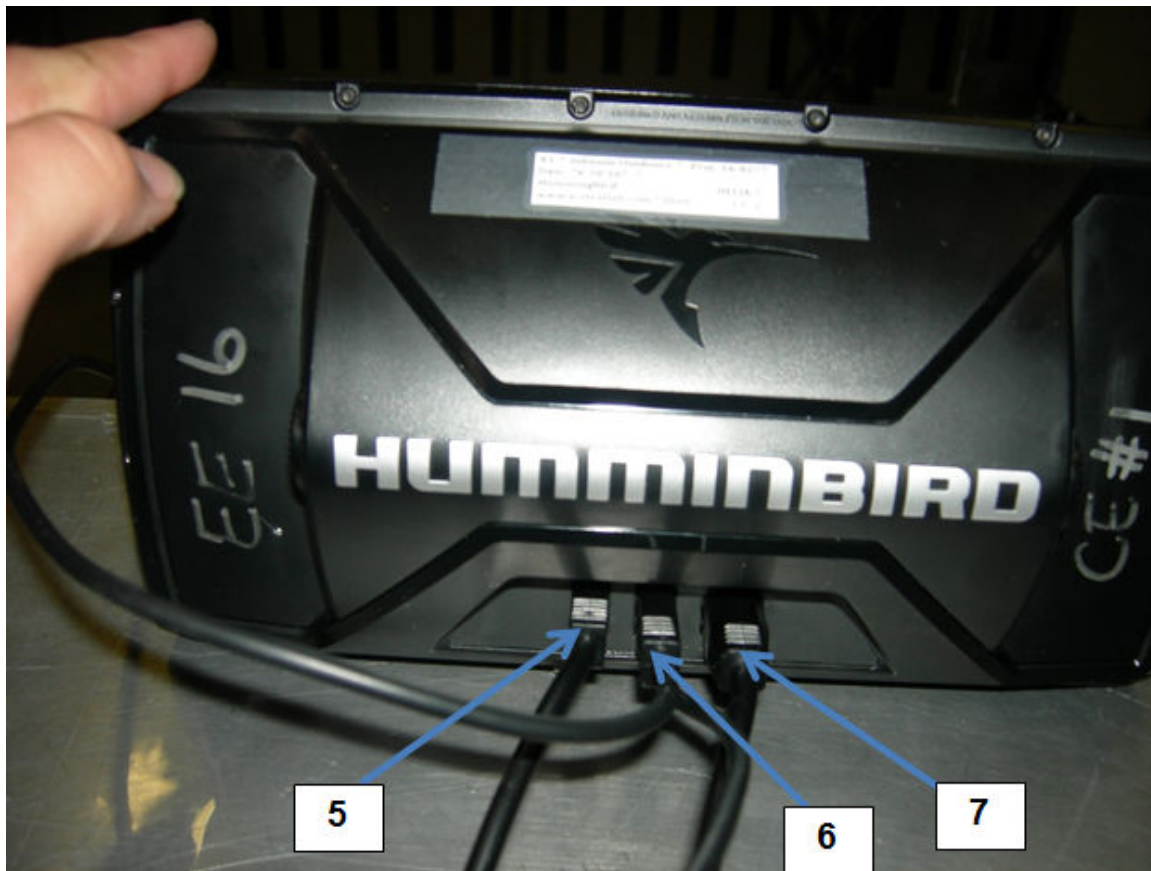


Figure 4.4-1: Test Setup Photograph

4.5 ESD Data Sheet

Test Point Photograph:





Test Point Selection:

TEST POINT#	DESCRIPTION	TYPE (C/A)
1	Seams on casing	Air
2	Seams on casing	Air
3	Screen	Air
4	Control buttons	Air
5	Power cable plug	Air
6	GPS cable plug	Air
7	Transducer cable plug	Air

4.6 Test Data

Test Parameters:

Test Date:	June 21, 2016	Temperature (°C)	24
Technician:	Art Sumner	Humidity (%)	34
Equipment Class:	N/A	Barometric Pressure (mBar)	1020
		<input checked="" type="checkbox"/> Pre-test verification complete	
Tested Modes:	Powered ON; GPS active, measuring depth		
AC Input Power:	N/A	VCP Resistor Value Check:	944K
DC Input Power:	12Vdc battery	HCP Resistor Value Check:	954K

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 checked="" 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	Air	Pass	

Notes:

5.0 Annex 1-2 (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 #	Last Calibration Date	Calibration Due Date
370	IFI	CMX5002	Amplifier	L364-0407	NCR	NCR
Re89	Amplifier Research	25S1G4A	Amplifiers	324609	NCR	NCR
565	United Microwave Products, Inc.	OO-190-15.00.0	Cables	565	NCR	NCR
684	Rohde & Schwarz	SML03	Signal Generators	103503	11/4/2015	11/4/2016
642	Fairview Microwave	FMC0101951-200CM	Cables	N/A	NCR	NCR
566	United Microwave Products, Inc.	OO-190-00-120.0	Cables	566	NCR	NCR
329	A.H.Systems	SAS-571	Antennas	721	7/22/2015	7/22/2017
354	ETS Lindgren	3142C	Antennas	78838	NCR	NCR
1112	Wandel & Goltermann	BN2244/21	Probes	H0006	12/3/2015	12/3/2016
1201	Wandel & Goltermann	2244/99.22	Probes	W-0004	12/3/2015	12/3/2016

NCR = No Calibration Required

5.3 Test Methodology

Annex 1-2 (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 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.

5.3.1 Test Criteria

Annex 8-1 (KN 301 489-1) and Annex 8-8 (KN 301 489-3) 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

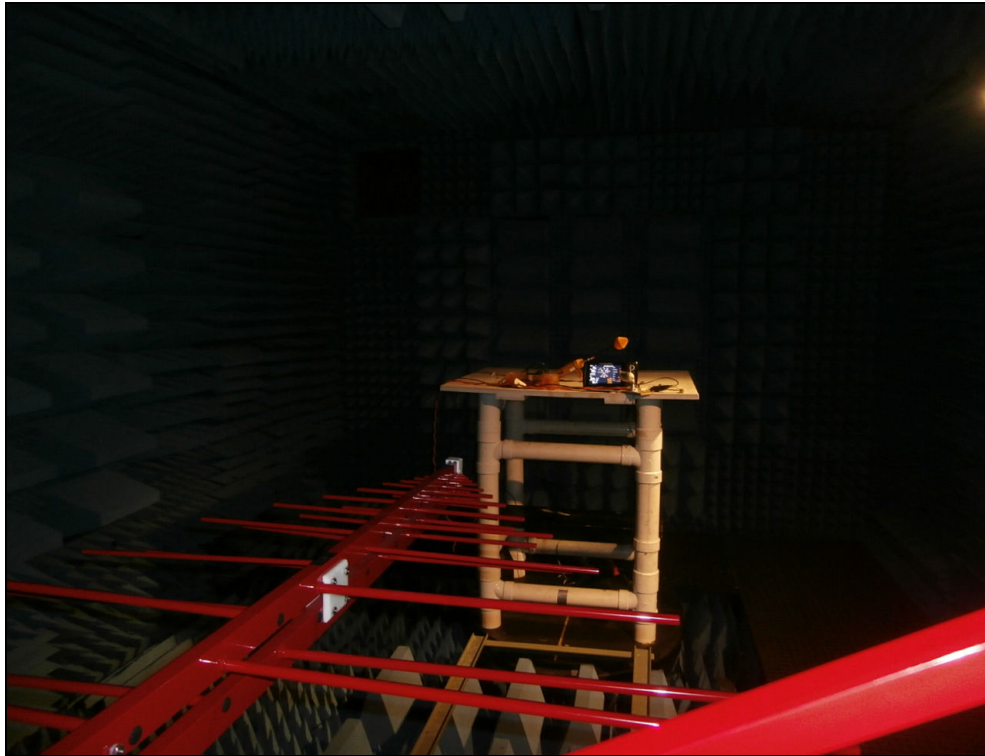


Figure 5.4-1: Test Setup Photograph

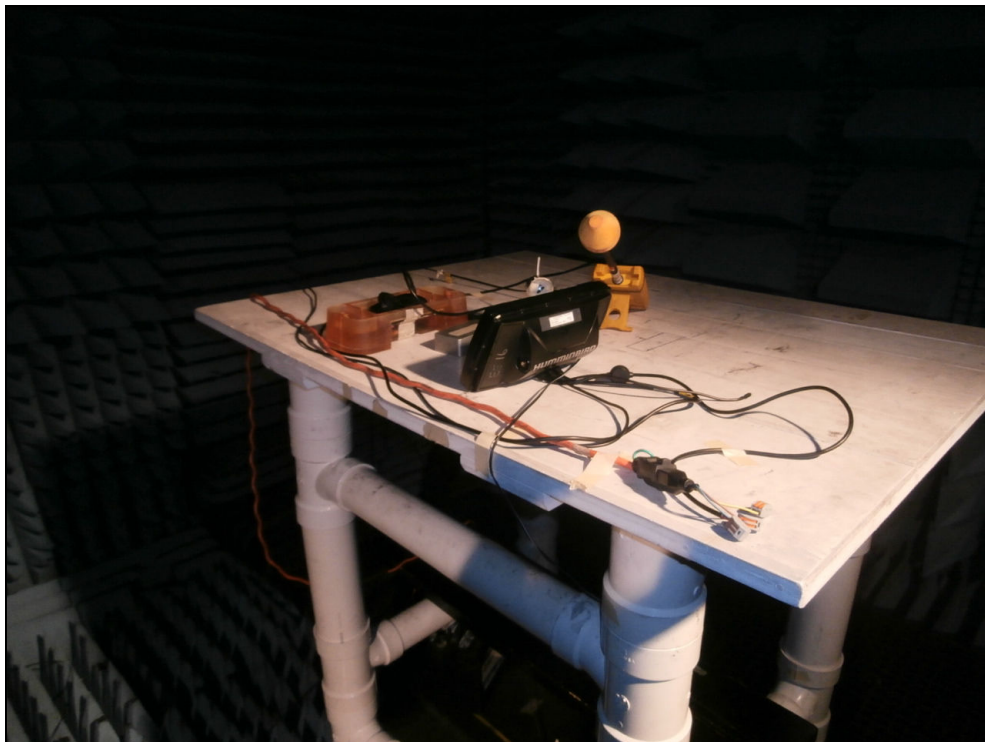


Figure 5.4-2: Test Setup Photograph

5.5 Test Results

Test Parameters:

Test Date:	June 23, 2016	Temperature (°C)	24.6C
Technician:	Don Brenner / Art Sumner	Humidity (%)	47.7%
Equipment Class:	N/A	Barometric Pressure (mBar)	1011.0mb
Tested Modes:	Powered monitoring GPS satellites, GPS position, time, Temperature, depth		
AC Input Power:	N/A	<input checked="" type="checkbox"/> Pre-test Verification Complete	
DC Input Power:	12Vdc battery		

Test Data:

Check All That Apply to This Data			
Polarity <input type="checkbox"/> Horizontal <input type="checkbox"/> Vertical <input checked="" type="checkbox"/> Both	Field Strength: <input checked="" type="checkbox"/> 3V/m <input type="checkbox"/> 10V/m <input type="checkbox"/> 8V/m <input type="checkbox"/> Enter Other Level Here	Freq. Band: <input checked="" type="checkbox"/> 80-1000MHz <input checked="" type="checkbox"/> 1.4-2.7GHz <input type="checkbox"/> Enter Other Band Here	Dwell Time <input type="checkbox"/> 1 Second <input checked="" type="checkbox"/> 3 Seconds <input type="checkbox"/> Enter Other
Azimuth	Result	Observation (Describe any detectable event)	
0	Pass		
90	Pass		
180	Pass		
270	Pass		

Notes:

6.0 Annex 1-3 (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 #	Last Calibration Date	Calibration Due Date
62	Haefely Trench	EFT Clamp	Immunity Equipment	None	7/17/2015	7/17/2016
474	Keytek	EMC PRO	General Lab Equipment	9808246	10/7/2015	10/7/2016
336	Tektronix	TDS 1012B	Scopes	C010189	7/15/2015	7/15/2016
503	Key Tek	TC-50	Cables	n/a	12/30/2015	12/30/2016
611	Teseq	INA 265B	Attenuators	73054	8/12/2015	8/12/2016

NCR = No Calibration Required

6.3 Test Methodology

Annex 1-3 (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 8-1 (KN 301 489-1) and Annex 8-8 (KN 301 489-3) 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:

9.4 Test Setup Photographs

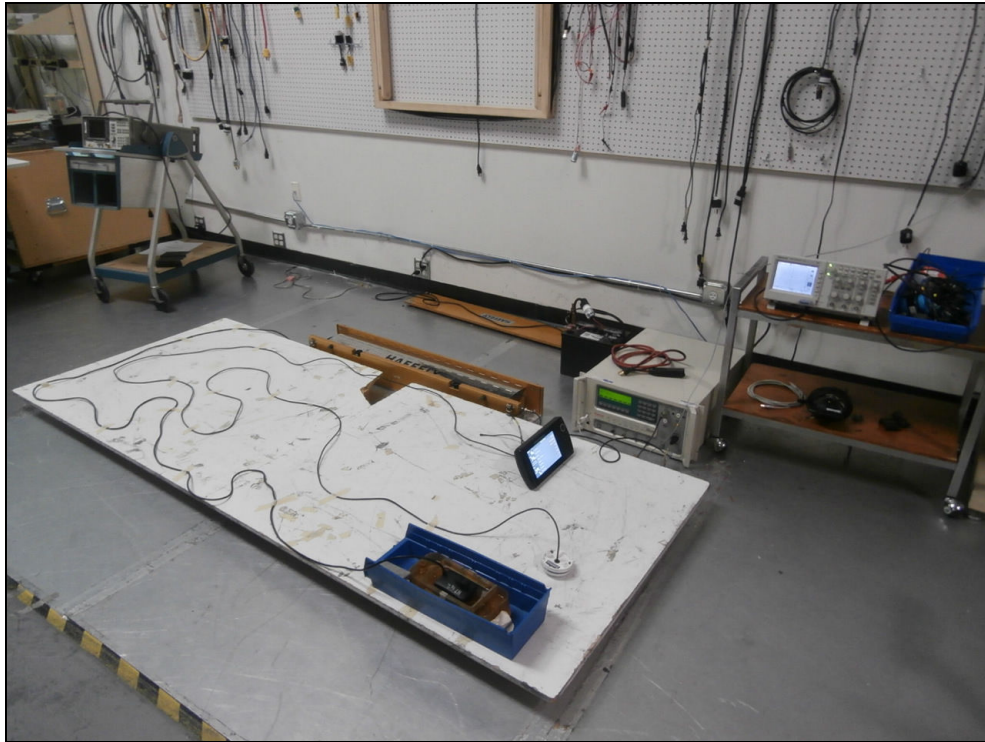


Figure 9.4-1: Test Setup Photograph

9.5 Test Results

Test Parameters:

Test Date:	June 21, 2016	Temperature (°C)	23.5
Technician:	Jaime Smith	Humidity (%)	39.9
Equipment Class:	N/A	Barometric Pressure (mBar)	1017.1
Tested Modes:	Powered On , GPS, Depth Level		
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)
L1	Pass	
L2	Pass	
L1-L2	Pass	

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 checked="" type="checkbox"/> 1kV <input type="checkbox"/> 2kV <input type="checkbox"/> Enter Other Level Here	
Signal Line	Result	Observation (Describe any detectable event)
GPS	Pass	
Depth Transducer	Pass	

Notes:

7.0 Annex 1-4 (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:

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

8.0 Annex 1-5 (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 #	Last Calibration Date	Calibration Due Date
93	Chase	8101	Clamp	65	5/6/2016	5/6/2017
364	Amplifier Research	DC2600A	Coupler	322466	NCR	NCR
370	IFI	CMX5002	Amplifier	L364-0407	NCR	NCR
425	ACS	EMC Cable Set	Cable Set	425	NCR	NCR
427	Electro-Metrics	PCL-258-98	Probe	n/a	NCR	NCR
457	Com Power	CDN-M2-25	Coupler	511023	7/15/2015	7/15/2016
471	Bird Technologies Group	150-A-FFN-06	Attenuators	914	NCR	NCR
624	Advantest	R3261C	Spectrum Analyzers	31720426	NCR	NCR
642	Fairview Microwave	MC0101951-200C	Cables	N/A	NCR	NCR
684	R&S	SML03	SIGGEN	3425	11/4/2015	11/4/2016

NCR = No Calibration Required

8.3 Test Methodology

Annex 1-5 (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 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.

8.3.1 Test Criteria

Annex 8-1 (KN 301 489-1) and Annex 8-8 (KN 301 489-3) 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

8.5 Test Results

Test Parameters:

Test Date:	June 22, 2016	Temperature (°C)	30.0C
Technician:	Reed Martin	Humidity (%)	36.10%
Equipment Class:	N/A	Barometric Pressure (mBar)	1018.2mb
Tested Modes:	GPS Functionality, Transducer Cable, Overall Functionality		
AC Input Power:	N/A	<input checked="" type="checkbox"/> Pre-Test Verification	
DC Input Power:	12VDC		

Mains Test Data:

Check All That Apply to This Data		
Test Level: <input checked="" type="checkbox"/> 3Vrms <input type="checkbox"/> 10Vrms <input type="checkbox"/> 15Vrms <input type="checkbox"/> Enter Other Level Here	Freq. Band: <input checked="" type="checkbox"/> .150-80MHz <input type="checkbox"/> 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: <input checked="" type="checkbox"/> 3Vrms <input type="checkbox"/> 10Vrms <input type="checkbox"/> 15Vrms <input type="checkbox"/> Enter Other Level Here	Freq. Band: <input checked="" type="checkbox"/> .150-80MHz <input type="checkbox"/> Enter Other Band Here	
Signal Line	Result	Observation (Describe any detectable event)
GPS	Pass	
Transducer Cable	Pass	

Notes:

9.0 Annex 1-6 (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 applicable, because the EUT does not employ magnetically sensitive components.

10.0 Annex 1-7 (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:

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.