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EMC Technical Report

Prepared For: JOHNSON OUTDOORS

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

In Accordance with the Conformity Assessment Procedure for Electromagnetic Interference (RRA Announce 2018-99, Oct 12, 2018)

EMI Product Standard: Annex 14 (KN 60945)

Report Number: 72141977.10N4
Report Revision: D
Report Issue Date: March 22, 2019

This report contains Page 29 pages

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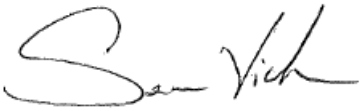

Sean Vick
EMC Team Lead
TÜV SÜD America Inc.

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

REVISION HISTORY Report Number: 72141977.10N4 Manufacturer: JOHNSON OUTDOORS Model: FORMTEXT |HELIX 9X MSI GPS G3N					
DATE	OLD REVISION	NEW REVISION	REASON	PAGES AFFECTED	APPROVED BY
December 3, 2018	---	A	Initial Release	All	Sean Vick
January 10, 2019	A	B	Removed Watermark on page 1. Updated page 4 Highest Data Rate and Source. Fixed pages 7, 8 and 9 “Error! Reference Source not found.	1, 4, 7, 8, 19	Sean Vick
March 15, 2019	B	C	Removed HELIX 8 references	All	Sean Vick
March 22, 2019	C	D	Revised basic and variant model names	All	Sean Vick

Project Information Sheet

Applicant Details

Manufacturer: JOHNSON OUTDOORS
Street Address: 1220 Old Alpharetta Road Suite 340
City, State/Province and Postal Code: Alpharetta, GA 30005
Country: USA
Contact: Kim Lincoln

Phone: +177088862921076
Fax:
Email: Kim.Lincoln@johnsonoutdoors.com

Sample Information

Model: FORMTEXT |HELIX 9X MSI **GPS G3N**
Model Variant(s): HELIX 9 CHIRP GPS G3N, HELIX 9X CHIRP GPS G3N, HELIX 9 MDI GPS G3N, HELIX 9X MDI GPS G3N, HELIX 9 MSI GPS G3N, HELIX 9X MSI GPS G3N
Environment of Use: Residential
Sample Receive Date: October 2, 2018
Sample Receive Condition: Good
Test Mode Description: Powered ON; Monitoring depth, speed, temp, GPS
Unacceptable Degradation (Provided by Mfg.): Not Applicable
Highest Data Rate: 800MHz **Source:** Main processor

Product Description

FORMTEXT |HELIX 9X MSI **GPS G3N**
Helix 9X Chirp MSI GPS G3N – main unit – supports 2D, MDI and MSI Sonar with GNSS receiver, BT/BLE and Ether net port
Helix 9X Chirp MDI GPS G3N – same as main but MSI Sonar is disabled via software
Helix 9X Chirp GPS G3N – same as main unit but MSI and MDI Sonar disabled via software

Test Information

Test Start Date: October 2, 2018
Test End Date: October 26, 2018
Emissions Pre-scan Site: SAC
Final Emissions Site: OATS
EMI Freq. Band: 10KHz-2GHz
Radiated Emissions Equipment Class: Class B
Harmonic Current EMI Class: N/A

Test Methods Applied

☒ RRA Public Notification 2017-19 Dec 28, 2017**:** Korea Technical Requirements for Electromagnetic Compatibility
☒ KN 60945 (Annex 14) Test Methods for Electromagnetic Compatibility with RRA Announce 2018-99 (Oct 12, 2018)

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 (KN 60945) and details the results of testing performed on October 2, 2018 through October 26, 2018 on the model FORMTEXT |HELIX 9X MSI **GPS G3N** manufactured by JOHNSON OUTDOORS .

1.2 Purpose

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

1.3 Results Summary

Product Standard or Test Method Applied	Description	Result
Product Standards		
KN 60945	Maritime navigation and radiocommunication equipment and systems – General requirements – Methods of testing and required test results	Pass
EN 61000-3-2:2014	Electromagnetic compatibility (EMC) -- Part 3-2: Limits - Limits for harmonic current emissions (equipment input current <= 16 A per phase)	N/A
EN 61000-3-3:2013	Electromagnetic compatibility (EMC) - Part 3-3: Limits - Limitation of voltage changes, voltage fluctuations and flicker in public low-voltage supply systems, for equipment with rated current <= 16 A per phase and not subject to conditional connection	N/A
Basic Immunity Standards per KN 60945		
KN 61000-4-2	Electromagnetic compatibility (EMC) - Part 4-2: Testing and measurement techniques - Electrostatic discharge immunity test	Pass
KN 61000-4-3	Electromagnetic compatibility (EMC) - Part 4-3: Testing and measurement techniques - Radiated, radio-frequency, electromagnetic field immunity test	Pass
KN 61000-4-4	Electromagnetic compatibility (EMC) - Part 4-4: Testing and measurement techniques - Electrical fast transient/burst immunity test	Pass
KN 61000-4-5	Electromagnetic compatibility (EMC) - Part 4-5: Testing and measurement techniques - Surge immunity test	N/A
KN 61000-4-6	Electromagnetic compatibility (EMC) - Part 4-6: Testing and measurement techniques - Immunity to conducted disturbances, induced by radio-frequency fields	Pass
KN 61000-4-8	Electromagnetic compatibility (EMC) - Part 4-8: Testing and measurement techniques - Power frequency magnetic field immunity test	N/A
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 Emissions Performance Criteria

For model HELIX 9X MSI GPS G3N the limits which apply are Class Bfound in Table 1.4.1-1 below:

Table 1.4.1-1 Emissions Limits

	Portable	Protected	Exposed	Submerged
Conducted emissions (9.2)		10 kHz – 150 kHz 150 kHz – 350 kHz 350 kHz – 30 MHz	63 mV – 0,3 mV (96 dBµV – 50 dBµV) 1 mV – 0,3 mV (60 dBµV – 50 dBµV) 0,3 mV (50 dBµV)	
Radiated emissions (9.3)	150 kHz – 300 kHz 300 kHz – 30 MHz 30 MHz – 2 GHz 156 MHz – 165 MHz	10 mV/m – 316 µV/m (80 dBµV/m – 52 dBµV/m) 316 µV/m – 50µV/m (52 dBµV/m – 34 dBµV/m) 500 µV/m (54 dBµV/m) except for 16 µV/m (24 dBµV/m) quasi-peak or 32 µV/m (30 dBµV/m) peak		

1.4.2 Immunity Performance Criteria

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

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

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

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

2.0 Test Facilities & Environment

2.1 Test Facilities

All testing was performed at the following address:

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

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

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

2.2 Laboratory Accreditations/Recognitions/Certifications

TÜV SÜD America, Inc. is accredited to ISO/IEC 17025 by the American Association for Laboratory Accreditation/A2LA accreditation program and has been issued certificate number 2955.09 in recognition of this accreditation. Unless otherwise specified, all tests methods described within this report are covered under the ISO/IEC 17025 scope of accreditation.

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

2.3 Test Environment

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

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

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

2.4 Test Equipment Calibration Statement

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

3.0 Equipment Under Test (EUT)

3.1 Manufacturer

JOHNSON OUTDOORS
1220 Old Alpharetta Road Suite 340
Alpharetta, GA 30005

Kim Lincoln
+177088862921076
Kim.Lincoln@johnsonoutdoors.com

3.2 Modifications

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

Table 3.2-1: EUT Modifications

☒ **Modifications <u>were not</u> required to bring the EUT into compliance with the requirements.** ☐ **Modifications <u>were</u> required to bring the EUT into compliance with the requirements.**

3.3 System Block Diagram and Support Equipment

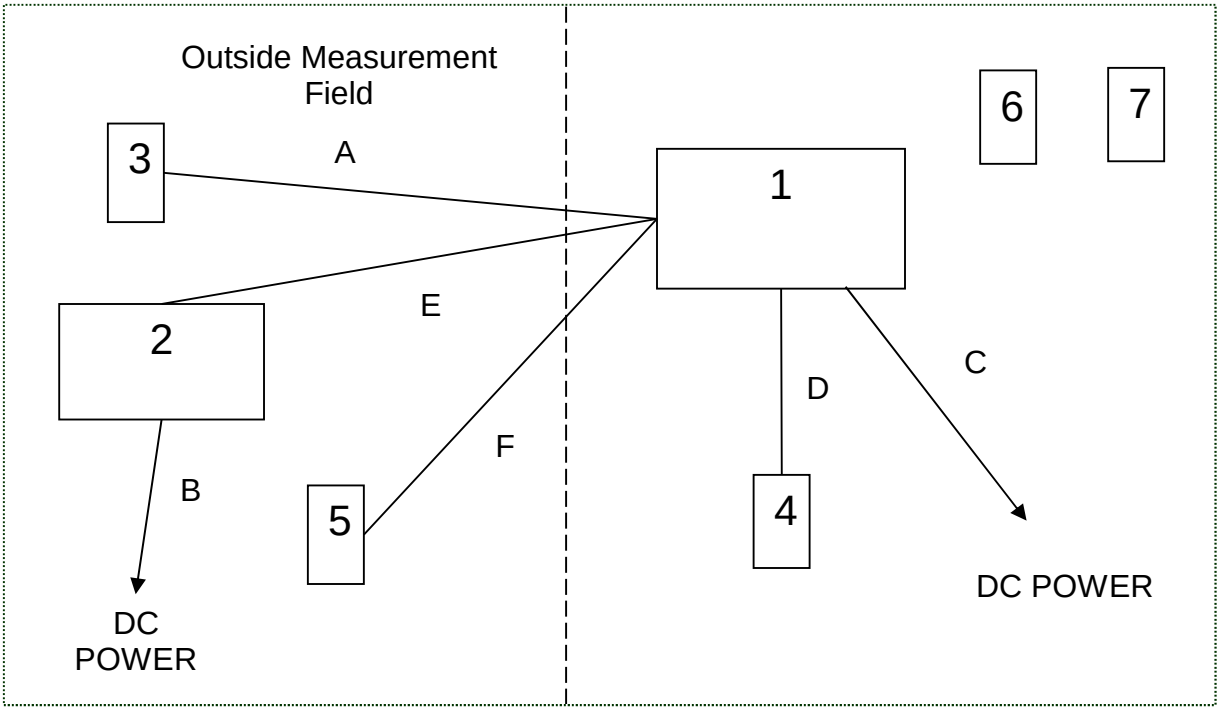

Figure 3.3-1: System Block Diagram

Table 3.3-1: EUT and Support Equipment Description

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

Table 3.3-2: Cable Description

Cable #	Cable Type	Length	Shield	Termination
A	GPS	20’	No	1 - 3
B	DC leads	3’	No	2 – DC power
C	DC leads	4’	No	1 – DC power
D	Transducer cable	20’	No	1 - 4
E	Ethernet	20’	No	1 - 2
F	Speed sensor cable	20’	No	1 - 5

3.4 Observations

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

Table 3.4-1: Observations

Observation No.	Description

3.5 EUT Photographs

Figure 3.5-1: EUT Photo – Front

Figure 3.5-2: EUT Photo – Back

SECTION B: EMISSIONS – TEST INFORMATION AND RESULTS

4.0 Radiated and Conducted Emissions

4.1 Radiated Emissions

4.1.1 Radiated Emissions Test Site

4.1.1.1 Open Area Test Site

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

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

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

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

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

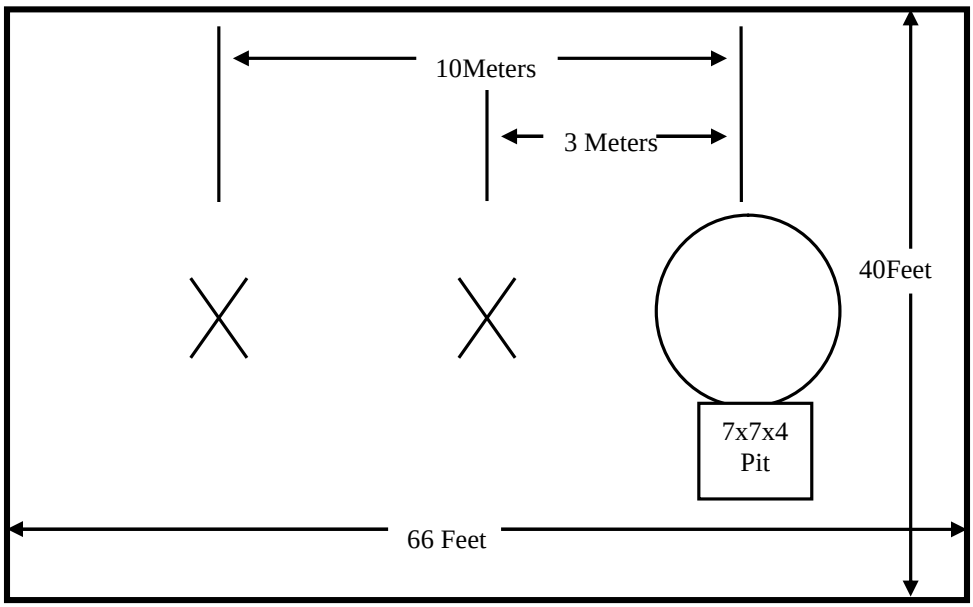

Figure 4.1.1.1-1: Open Area Test Site

4.1.1.2 Semi-Anechoic Chamber

The Semi-Anechoic Chamber Test Site consists of a 20'W x 30'L x 20'H shielded enclosure. The chamber is lined with ETS-Lindgren Ferrite Absorber, model number FT-1500. The ferrite tile 600 mm x 600 mm (2.62 in x 23.62 in) panels and are mounted directly on the inner walls of the chamber shield.

The specular regions of the chamber are lined with additional ETS-Lindgren PS-600 hybrid absorber to extend its frequency range up to 18GHz and beyond.

The turntable is a 2m ETS-Lindgren Model 2170, and installed off the center axis is located 5'6" from the back wall of the chamber. The chamber is grounded via 1 - 8' copper ground rod, installed at the center of the back wall, it is bound to the shield using #8 solid copper wire.

The antenna mast is an EMCO 1060 and is remotely controlled from the control room for both antenna height and polarization.

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

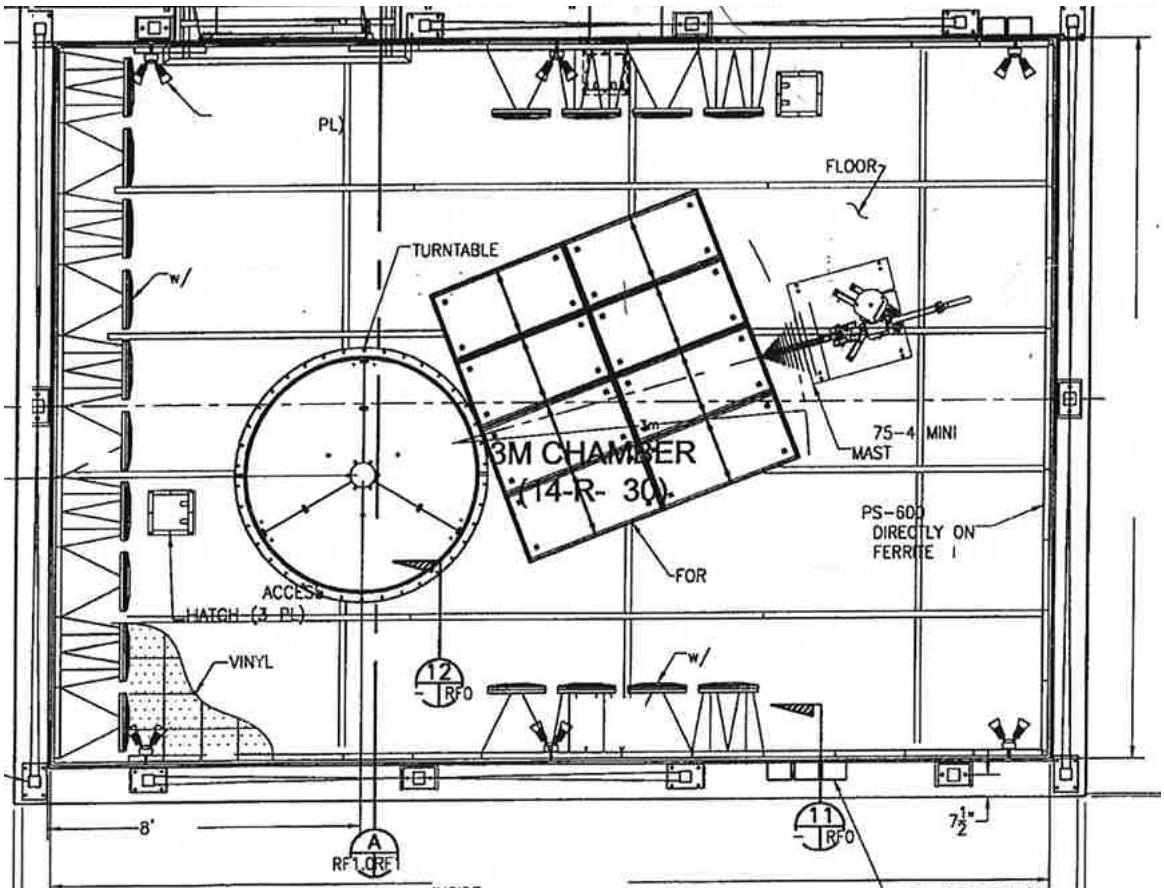

Figure 4.1.1.2-1: Semi-Anechoic Chamber Test Site

4.1.1.3 Fully Anechoic Chamber

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

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

The chamber is grounded via 1 - 8' copper ground rod, installed at the center of the back wall, it is bound to the shield using 3/4" stainless steel braided cable. The turntable is a remotely controlled EMCO Model 1060 and is 150cm in diameter and is located 1m from the absorber on the back wall of the chamber.

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

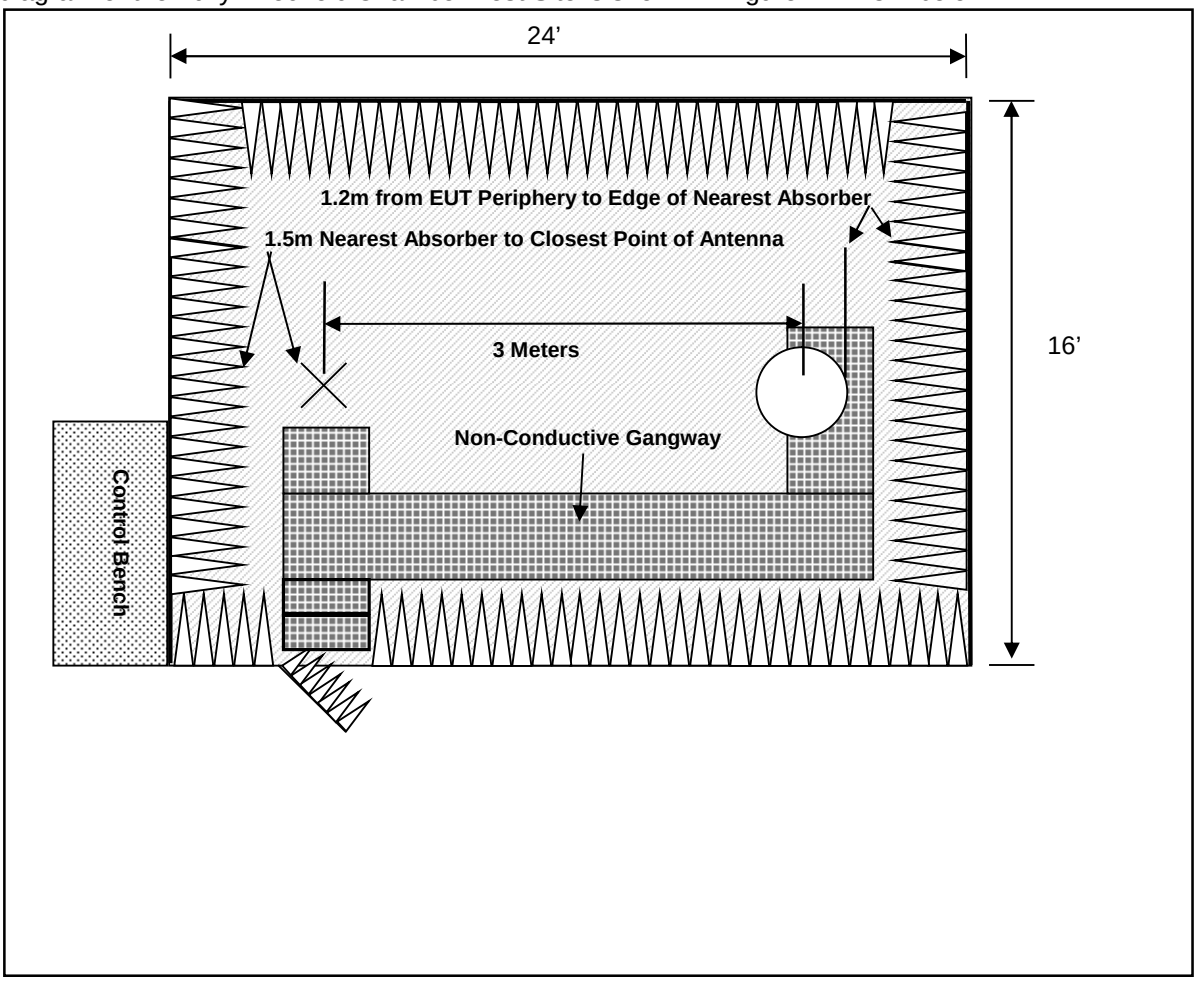

Figure 4.1.1.3-1: Fully Anechoic Chamber Test Site

4.1.2 Test Equipment

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

Table 4.1.2-1 Test Equipment – Radiated Emissions

Semi-Anechoic Chamber

AssetID	Manufacturer	Model#	Equipment Type	Serial#	Calibration Performed Date	Calibration Due Date
731	EMCO	3104	Antennas	2659	11/09/2016	11/09/2018
213	TEC	PA 102	Amplifiers	44927	7/19/2018	7/19/2019
836	ETS Lindgren	Chamber B EMI Cable Set	Cable Set	836	5/1/2018	5/1/2019
412	Electro Metrics	LPA-25	Antennas	1241	8/22/2018	8/22/2020
819	Rohde & Schwarz	ESR26	EMI Test Receiver	101345	10/31/2017	10/31/2018
90	Electro-metrics	LPA25	Antennas	1476	1/3/2018	1/3/2020
144	Omega	RH411	Climate Monitoring Equipment	H0103373	9/1/2016	3/11/2019

Semi-Anechoic Chamber High Frequency

AssetID	Manufacturer	Model#	Equipment Type	Serial#	Calibration Performed Date	Calibration Due Date
30	Spectrum Technologies	DRH-0118	Antennas	970102	5/9/2017	5/9/2019
338	Hewlett Packard	8449B	Amplifiers	3008A01111	7/11/2017	7/11/2019
836	ETS Lindgren	Chamber B EMI Cable Set	Cable Set	836	5/1/2018	5/1/2019
819	Rohde & Schwarz	ESR26	EMI Test Receiver	101345	10/31/2017	10/31/2018
144	Omega	RH411	Climate Monitoring Equipment	H0103373	9/1/2016	3/11/2019

Open Area Test Site

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

NCR = No Calibration Required

4.1.3 Test Methodology

4.1.3.1 Pre-Scans

Radiated pre-scans are performed on all EUT's in either the 3m Semi-Anechoic or the 3m Fully-Anechoic Chamber. Final emission testing for Class A equipment is performed on the 3/10m Open Area Test Site (OATS) as described in section 4.1.1.1. Final emission testing on Class B equipment can be performed either in the 3m Semi-Anechoic chamber described in section 4.1.1.2 or on the OATS.

Pre-scans are a method by which the 10 highest emissions can be identified for final evaluation. This is achieved by taking automated emission snapshots of the EUT at various azimuths and antenna heights. The software is programmed to perform a peak sweep of the band using the maxhold function. This sweep is performed every 90º in both horizontal and vertical polarities and at antenna heights of 100cm and 300cm. Although not a fully maximized scan, the pre-scan gives a good indication of pass or fail.

4.1.3.2 Final Scans

Radiated emissions measurements were made over the frequency range of 150kHz – 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 are taken above 1000MHz with the RBW set to 1MHz and VBW set to 10Hz. The calculation for the radiated emissions field strength is as follows:

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

4.1.3.3 Test Criteria

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

4.1.3.4 Test Justification

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

4.1.4 Test Setup Photographs

Figure 4.1.4-1: Radiated Emissions - Front View

Figure 4.1.4-2: Radiated Emissions - Rear View

4.1.5 Test Data

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

Test Parameters:

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

Test Data Table:

Measurement Distance:

☐ FAC ☐ SAC ☒ OATS
☐ 1 Meter ☐ 3 Meter ☒ 10 Meter

Frequency (MHz)	Measured Level (dBuV)		Antenna Polarity (H/V)	Antenna Height (cm)	Turntable Position (o)	Correction Factors (dB)	Corrected Level (dBuV/m)		Limit (dBuV/m)		Margin (dB)	
	Pk	Qpk/Av					Pk	Qpk/Av	Pk	Qpk/Av	Pk	Qpk/Av
42.07	41.70	37.10	V	100	90	-13.24	---------	23.86	--------	30.0	---------	6.1
250	34.70	29.50	H	150	270	-9.90	---------	19.60	--------	37.0	---------	17.4
350	25.50	15.10	H	100	360	-7.10	---------	8.00	--------	37.0	---------	29.0
98.4675	50.10	45.30	V	100	264	-11.71	---------	33.59	--------	40.5	---------	6.9
550	40.80	36.90	V	100	360	-2.50	---------	34.40	--------	47.5	---------	13.1
777.95	24.30	14.90	H	100	360	0.88	---------	15.78	--------	47.5	---------	31.7

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

Notes:

98.4675 MHz, 550 MHz, and 777.95 MHz measured in 3M SAC due to local ambient interference.
There were no significant emissions detected above 1GHz.

4.2 Conducted Emissions

4.2.1 Conducted Emissions Test Site

The AC mains conducted EMI site is located in the main EMC lab. It consists of a 12' x 10' horizontal coupling plane(HCP) as well as a 12'x10' vertical coupling plane(VCP). The HGP is constructed of 4' x 10' sheets of particle board sandwiched by galvanized steel sheets. These panels are bonded using 11AWG 1/8" x 2" by 10' galvanized sheet steel secured to the panels via by screws. The VCP is constructed of three 4'x8' sheets of 11AWG solid aluminum.

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

The site is of sufficient size to test table top and floor standing equipment in accordance with section 6.1.4 of ANSI C63.4:2014.

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

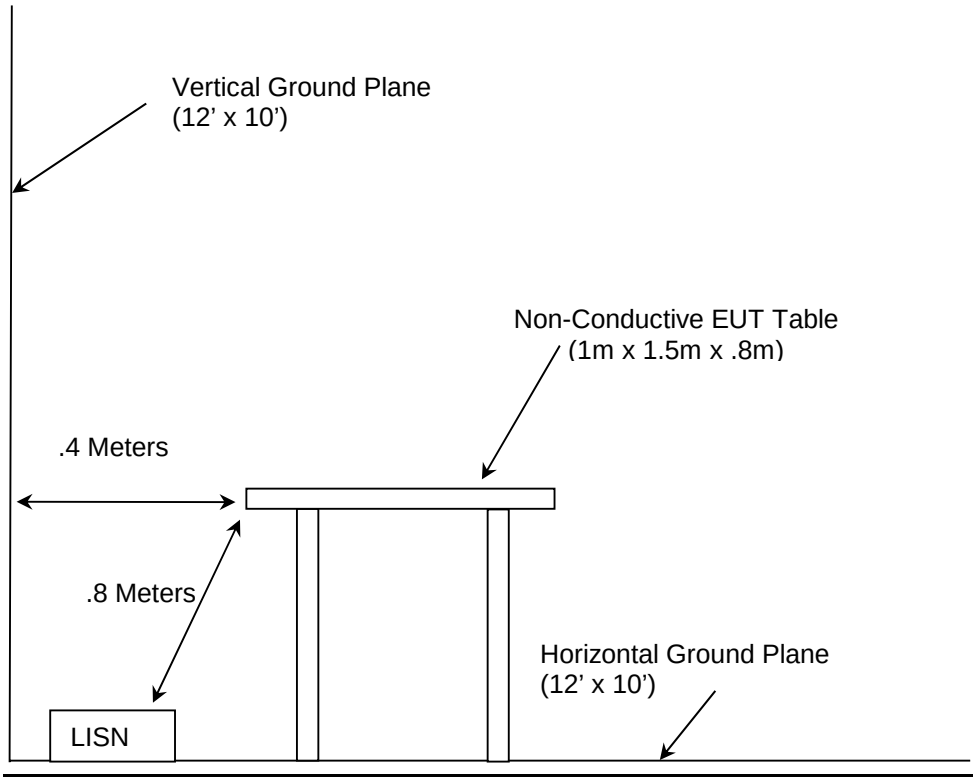

Figure 4.2.1-1: AC Mains Conducted EMI Site

4.2.2 Test Equipment

Table 4.2.2-1 Test Equipment – Conducted Emissions

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

Conducted Emissions Telecom

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

NCR = No Calibration Required

4.2.3 Test Methodology

Conducted emissions were performed from 10kHz to 30MHz with the spectrum analyzer's resolution bandwidth set to 200Hz and 9kHz and the video bandwidth set to 30kHz. EUT setup per KN 60945 without the use of the EUT identified in Figure 4.2.1-1. The calculation for the conducted emissions is as follows:

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

4.2.3.1 Test Criteria

The EUT must meet the limits as given in section 1.4.1.

4.2.3.2 Test Justification

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

4.2.4 Test Setup Photographs

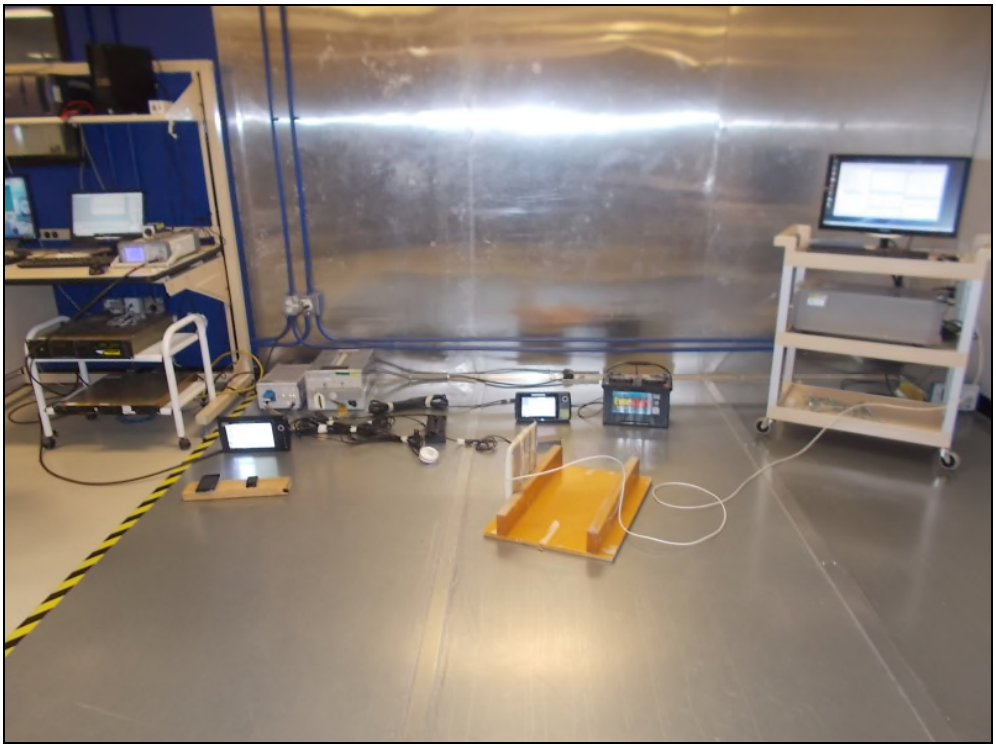

Figure 4.2.4-1: Conducted Emissions Test Setup – Front View

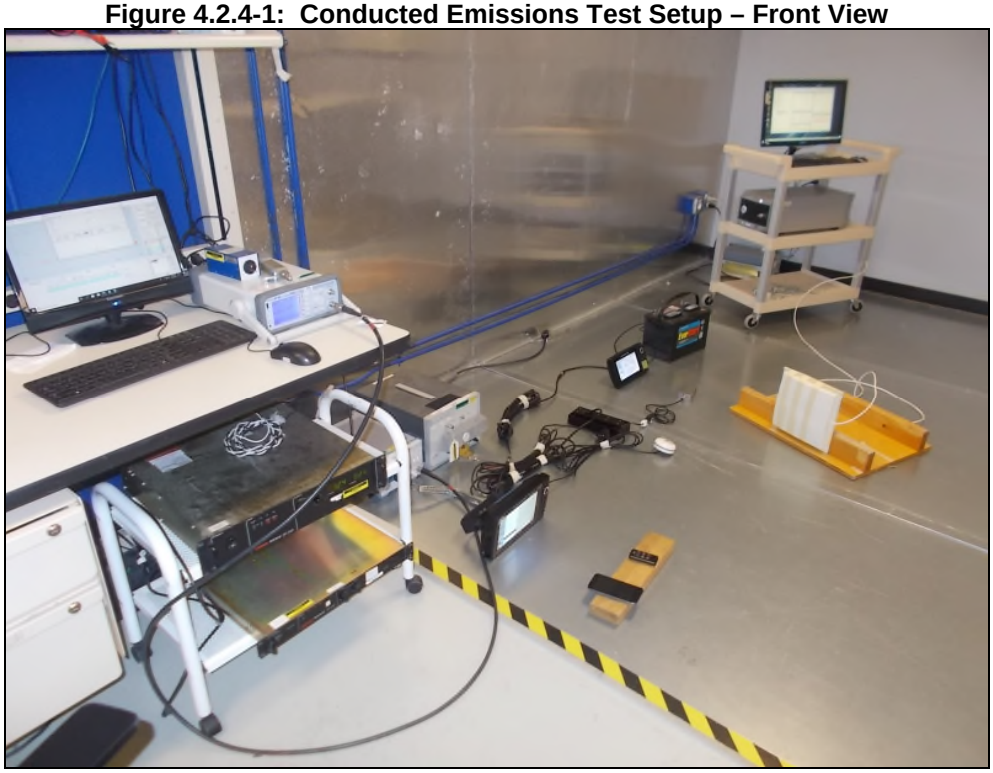

Figure 4.2.4-2: Conducted Emissions Test Setup – Side View

4.2.5 Test Data

Tabulated data is given in the Test Data Tables below.

Test Parameters:

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

Tested Leads:

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

Line 1							
Frequency (MHz)	Corrected Reading		Limit		Margin		
	Quasi-Peak (dBuV)	Average (dBuV)	Quasi-Peak (dBuV)	Average (dBuV)	Quasi-Peak (dB)	Average (dB)	Correction (dB)
0.01	23.45	-----	96	-----	-72.55	-----	10.07
0.0102	23.43	-----	95.66	-----	-72.23	-----	10.06
0.0604	24.51	-----	65.45	-----	-40.94	-----	9.6
0.121	37.72	-----	53.65	-----	-15.93	-----	9.59
3.398	34.98	-----	50	-----	-15.02	-----	9.62
3.458	39.71	-----	50	-----	-10.29	-----	9.62
6.362	40.65	-----	50	-----	-9.35	-----	9.66
6.574	40.52	-----	50	-----	-9.48	-----	9.66
6.634	40.05	-----	50	-----	-9.95	-----	9.66
6.902	43.61	-----	50	-----	-6.39	-----	9.67
7.774	43.27	-----	50	-----	-6.73	-----	9.67
7.982	40.63	-----	50	-----	-9.37	-----	9.67
8.042	41.47	-----	50	-----	-8.53	-----	9.67
8.486	40.89	-----	50	-----	-9.11	-----	9.67

Notes:

Line 2							
Frequency (MHz)	Corrected Reading		Limit		Margin		
	Quasi-Peak (dBuV)	Average (dBuV)	Quasi-Peak (dBuV)	Average (dBuV)	Quasi-Peak (dB)	Average (dB)	Correction (dB)
0.01	23.38	-----	96	-----	-72.62	-----	10
0.0102	23.36	-----	95.66	-----	-72.3	-----	9.99
0.0605	24.73	-----	65.42	-----	-40.69	-----	9.6
0.121	38.02	-----	53.65	-----	-15.63	-----	9.59
3.482	42.47	-----	50	-----	-7.53	-----	9.62
6.358	38.17	-----	50	-----	-11.83	-----	9.65
6.718	40.91	-----	50	-----	-9.09	-----	9.66
6.838	40.46	-----	50	-----	-9.54	-----	9.66
6.898	42.16	-----	50	-----	-7.84	-----	9.66
7.434	41.82	-----	50	-----	-8.18	-----	9.66
7.826	41.46	-----	50	-----	-8.54	-----	9.67
8.126	43.29	-----	50	-----	-6.71	-----	9.67
8.186	42.8	-----	50	-----	-7.2	-----	9.67
8.486	41.88	-----	50	-----	-8.12	-----	9.67

Notes:

SECTION D: MEASUREMENT UNCERTAINTY

General
Measurement Uncertainty is based on the following publications:

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

Calculations for measurement uncertainty are available upon request.

Emissions:

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

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

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

If U_{Lab} is less than or equal to U_{cispr} in Table 5.0-1, then:

- compliance is deemed to occur if no measured disturbance exceeds the disturbance limit;
- non-compliance is deemed to occur if any measured disturbance exceeds the disturbance limit.

If U_{Lab} is greater than U_{cispr}, then:

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

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

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

SECTION E: CONCLUSION

The EUT is determined to meet the requirements as defined in the applicable regulations.

Appendix A – ANAB Accreditation Certificate

CERTIFICATE OF ACCREDITATION

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

This is to certify that

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

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

ISO/IEC 17025:2005

while demonstrating technical competence in the field of

TESTING

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

AT-2021
Certificate Number

ANAB Approval

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

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