



Test Report to EN 300 328 V2.1.1

Wideband transmission systems;
Data transmission equipment operating in the 2,4 GHz ISM band and using wide band modulation techniques;
Harmonised Standard covering the essential requirements of article 3.2 of Directive 2014/53/EU

Report Number: AT72143353-2R1

Manufacturer: Johnson Outdoors, Inc

Model: SOLIX 12 MSI G2

Test Begin Date: November 27, 2018

Test End Date: November 29, 2018

Report Issue Date: January 11, 2019



FOR THE SCOPE OF ACCREDITATION UNDER Certificate Number: 2955.09

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

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This report contains 20 pages

Table of Contents

1	GENERAL	3
1.1	PURPOSE	3
1.2	MANUFACTURER INFORMATION	3
1.3	PRODUCT DESCRIPTION	3
1.4	TEST METHODOLOGY AND CONSIDERATIONS	5
1.5	MODIFICATIONS OF EUT.....	5
1.6	REFERENCES	5
2	TEST FACILITIES	6
2.1	LOCATION	6
2.2	LABORATORY ACCREDITATIONS/RECOGNITIONS/CERTIFICATIONS.....	6
2.3	RADIATED EMISSIONS TEST SITE DESCRIPTION.....	7
2.3.1	<i>Semi-Anechoic Chamber Test Site – Chamber A.....</i>	<i>7</i>
2.3.2	<i>Semi-Anechoic Chamber Test Site – Chamber B.....</i>	<i>8</i>
3	EQUIPMENT UNDER TEST SYSTEM BLOCK DIAGRAM.....	9
4	SUPPORT EQUIPMENT.....	9
5	CONCLUSIONS, OBSERVATIONS AND COMMENTS	10
6	MEASUREMENT UNCERTAINTY	10
7	TEST RESULTS SUMMARY	11
8	TEST RESULTS	13
8.1	TEST RESULTS DETAILS.....	13
8.1.1	<i>Transmitter unwanted emissions in the spurious domain.....</i>	<i>13</i>
9	TEST SETUP PHOTOGRAPHS	15
10	PHOTOGRAPHS OF THE EQUIPMENT (UUT)	17
11	TEST EQUIPMENT	20

1 GENERAL

1.1 Purpose

The purpose of this report is to demonstrate compliance with EN300 328.

1.2 Manufacturer Information

Johnson Outdoors Marine Electronics, Inc.
678 Humminbird Ln
Eufaula, AL 36027

1.3 Product Description

Product Name: SOLIX 12 MSI G2

The Humminbird SOLIX 12 MSI G2 (411030-1) is a fishfinder/GPS product with Side/Down imaging sonar capability to be used in the marine environment. It is comprised of a keypad, LCD display, Internal GPS, Ethernet, and capable of supporting external GPS, Ethernet, Wi-Fi/Bluetooth module, and both external NMEA 0183 and NMEA2K devices.

The SOLIX 12 MDI G2 CHO is identical to the SOLIX 12 MSI G2 with the exception of the SW settings that limit sonar to traditional 2D only and Down imaging.

Model variants include:

411030-1	SOLIX 12 MSI G2
411100-1CHO	SOLIX 12 MDI G2 CHO

Test Sample Serial Number(s): 180907222003

Technical Information (Redpine Module Bluetooth/BLE):

Detail	Description
Transmit Frequency / Alignment Range	2402 MHz – 2480 MHz
Receiver Frequency / Alignment Range	2402 MHz – 2480 MHz
Modulation Format	GFSK, $\pi/4$ -DQPSK, 8-DPSK
Rated RF Output Power	19dBm (Conducted)
Channel Spacing	1 MHz (Bluetooth) 2 MHz (BLE)
Operating Voltage	3.0-3.6 VDC
Adaptive	Yes
Antenna Type / Gain:	PCB Antenna / 0.99 dBi
Type of equipment:	Fixed
Software release:	6.680

Technical Information (Redpine Module WLAN):

Detail	Description
Transmit Frequency / Alignment Range	2412 - 2472 MHz
Receiver Frequency / Alignment Range	2412 - 2472 MHz
Modulation Format	802.11b: DSSS (DBPSK / DQPSK / CCK) 802.11g/n: OFDM (BPSK / QPSK / 16QAM / 64QAM)
Rated RF Output Power	18dBm (Conducted)
Channel Spacing	5 MHz
Operating Voltage	3.0-3.6 VDC
Adaptive	Yes
Antenna Type / Gain:	PCB Antenna / 0.99 dBi
Type of equipment:	Fixed
Software release:	6.680

Test Sample Condition: The test samples were provided in good working order with no visible defects.

1.4 Test Methodology and Considerations

No deviation from the test method was applied. The data presented in this report represents the worst case where applicable. This test report documents the radiated emissions of a previously evaluated radio module installed in a new host device. All other essential requirements are documented in a separate test report.

For Radiated Emissions, the EUT was programmed to generate a continuously modulated signal. The EUT was evaluated in an orientation typical of normal installation. See test setup photos for more information.

Software power setting during test:	BT Classic, EDR3/DH5; Channels 0 and 79: 22
	Bluetooth LE, 2Mbps; Channel 0: 20
	Bluetooth LE, 2Mbps; Channel 39: 17
	WLAN 802.11b, 1Mbps; Channel 1: 22
	WLAN 802.11b, 1Mbps; Channel 13: 22
	WLAN 802.11g, 6Mbps; Channel 1: 22
	WLAN 802.11g, 6Mbps; Channel 13: 22

1.5 Modifications of EUT

No modification of the EUT where required for compliance.

1.6 References

- ETSI EN 300 328 V2.1.1: Wideband transmission systems; Data transmission equipment operating in the 2,4 GHz ISM band and using wide band modulation techniques; Harmonised Standard covering the essential requirements of article 2.3 of Directive 2014/53/EU.

2 TEST FACILITIES

2.1 Location

The radiated and conducted emissions test sites are located at the following addresses:

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

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 scopes of accreditation.

The Semi-Anechoic Chamber Test Sites, Open Area Test Sites (OATS) and Conducted Emissions Sites have been fully described, submitted to, and accepted by the FCC, ISED Canada and the Japanese Voluntary Control Council for Interference by information technology equipment.

FCC Registration Number:	967699
ISED Canada Lab Code:	23932
VCCI Member Number:	1831
• VCCI Registration Number	A-0295

2.3 Radiated Emissions Test Site Description

2.3.1 Semi-Anechoic Chamber Test Site – Chamber A

The Semi-Anechoic Chamber Test Site consists of a 20' x 30' x 18' shielded enclosure. The chamber is lined with Toyo Ferrite Grid Absorber, model number FFG-1000. The ferrite tile grid is 101 x 101 x 19mm thick and weighs approximately 550 grams. These tiles are mounted on steel panels and installed directly on the inner walls of the chamber.

The turntable is 5' in diameter and 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 ground plane using 3/4" stainless steel braided cable.

The turntable is all steel, flush mounted EMCO Model 1060 installed in an all steel frame. The table is remotely operated from inside the control room located 25' 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.

Behind the turntable is a 3' x 6' x 4' deep shielded pit used for support equipment if necessary. The pit is equipped with 1 - 4" PVC chase from the turntable to the pit that allows 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 chamber rear wall is covered with a mixture of Siepel pyramidal absorber. The side walls of the chamber are partially covered with Siepel pyramidal absorber.

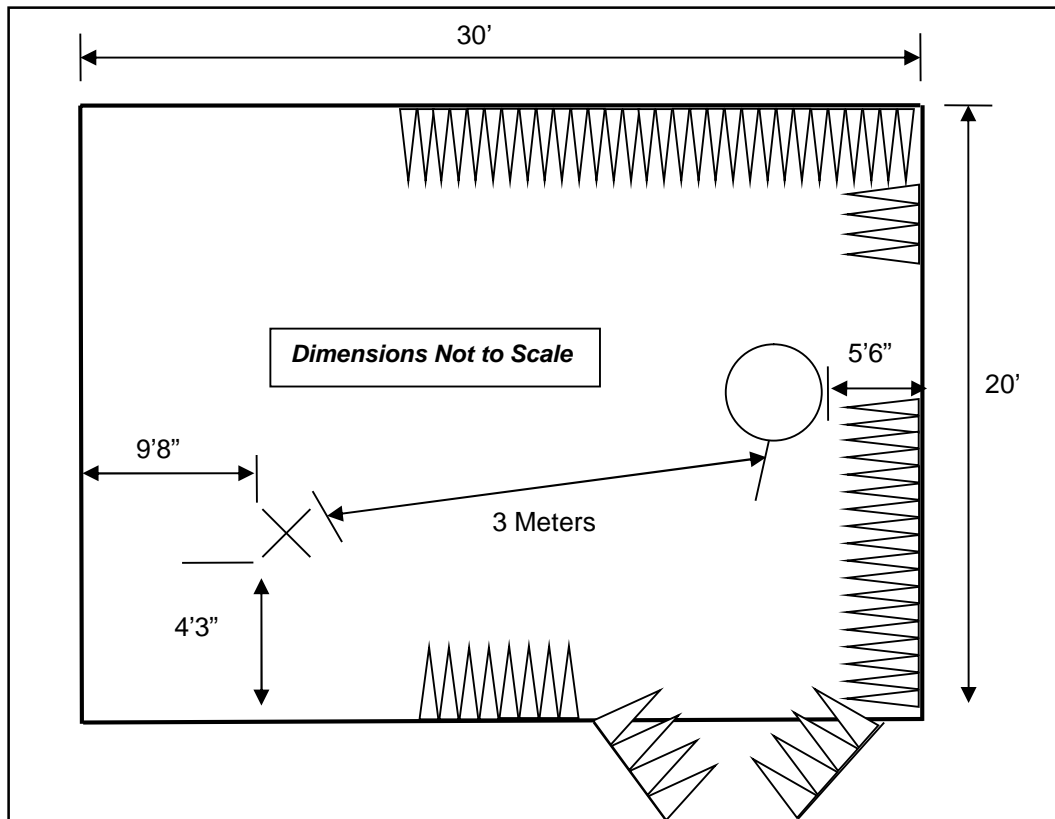


Figure 2.3.1-1: Semi-Anechoic Chamber Test Site – Chamber A

2.3.2 Semi-Anechoic Chamber Test Site – Chamber B

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.

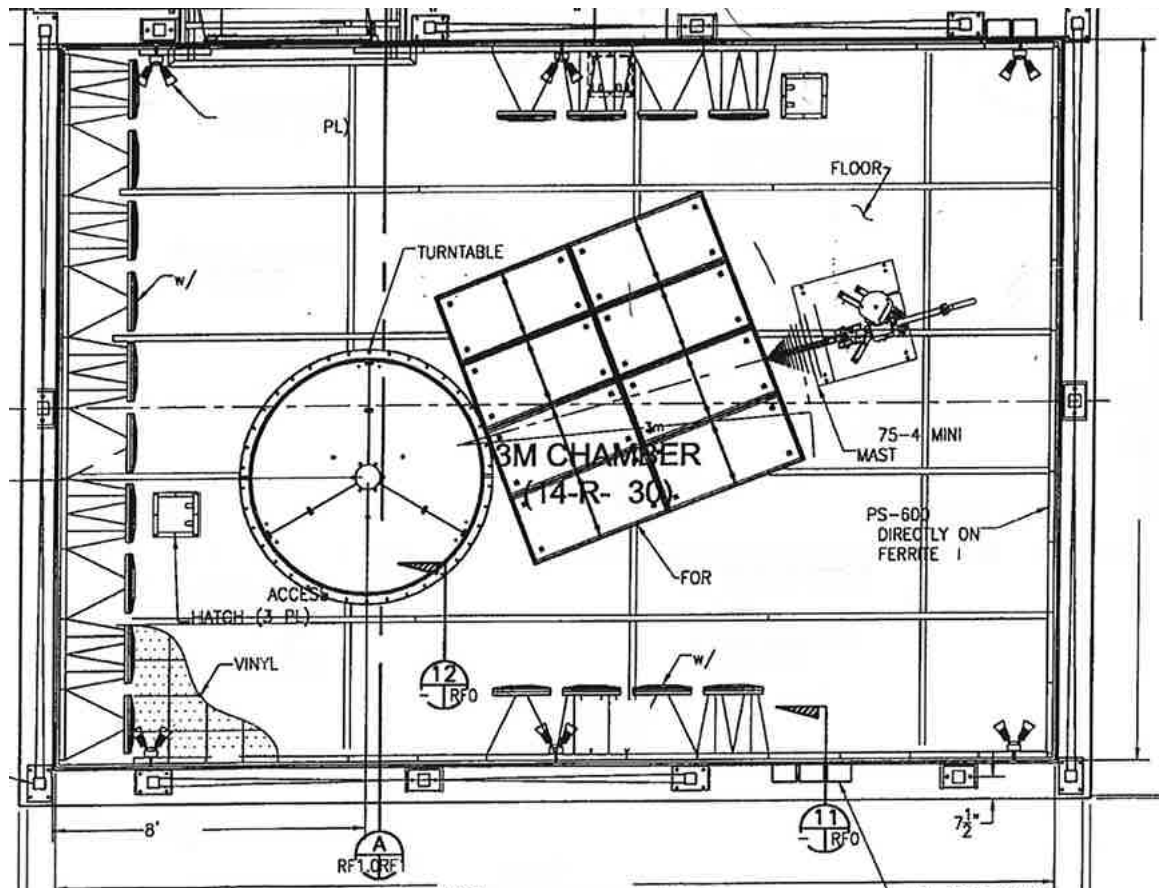


Figure 2.3.2-1: Semi-Anechoic Chamber Test Site – Chamber B

3 EQUIPMENT UNDER TEST SYSTEM BLOCK DIAGRAM

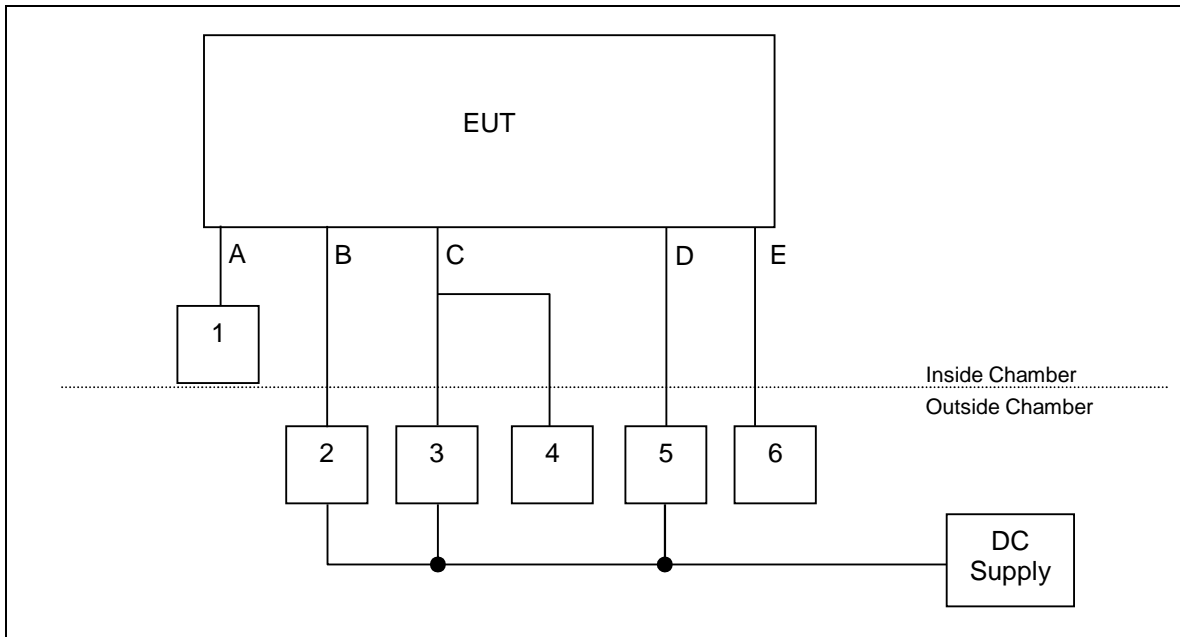


Figure 3-1: EUT System Block Diagram

4 SUPPORT EQUIPMENT

Table 4-1: Support Equipment

Item #	Type Device	Manufacturer	Model/Part #	Serial #
1	Marine Battery	AUTOCRAFT	29HM	N/A
2	External GPS Antenna	Maretron	N/A	N/A
3	Geonav	Techsonic Industries, Inc.	GTX AIS	46090073
4	External GPS Antenna	Johnson Outdoors	AS GPS HS	12071842-0039
5	Remote Unit	Johnson Outdoors	Solix 10 MSI+ G2	180925220206
6	Transducer	Johnson Outdoors	N/A	N/A

Table 4-2: Cable Description

Cable #	Cable Type	Length	Shield	Termination
A	DC Power Cable	1.9 m	No	EUT – 1
B	GPS Cable	5.3 m	No	EUT – 2
C	NMEA 0183	6 m	No	EUT – 3 / 4
D	Ethernet Cable	8.2 m	No	EUT – 5
E	Transducer Cable	6.3 m	No	EUT – 3

5 CONCLUSIONS, OBSERVATIONS AND COMMENTS

The test report will be filed at TÜV SÜD America, Inc. for a period of 10 years following the issue of this report. It may only be reproduced or published in full. Reproduction or publication of extracts from the report requires the prior written approval from TÜV SÜD America, Inc.

The results of the tests as stated in this report are exclusively applicable to the EUT as identified in this report. TÜV SÜD America, Inc. cannot be held liable for properties of the EUT that have not been observed during these tests.

TÜV SÜD America, Inc. assumes the sample to comply with the requirements of EN 300 328 for the respective test sector, if the test results turn out positive.

Comments: The provider was responsible for ensuring the test samples provided were representative of final production units.

6 MEASUREMENT UNCERTAINTY

In accordance with ETSI TR 100 028, measurement uncertainties associated with each test have been estimated and expressed in Table 6-1 below:

Table 6-1: Measurement Uncertainties

Parameter	U_{std}	U_{lab}
Occupied Channel Bandwidth	$\pm 5 \%$	$\pm 0.009 \%$
RF Output Power, Conducted	$\pm 1.5 \text{ dB}$	$\pm 0.349 \text{ dB}$
Power Spectral Density, Conducted	$\pm 3 \text{ dB}$	$\pm 0.372 \text{ dB}$
Unwanted Emissions, Conducted	$\pm 3 \text{ dB}$	$\pm 1.264 \text{ dB}$
All Emissions, Radiated	$\pm 6 \text{ dB}$	$\pm 5.814 \text{ dB}$
Temperature	$\pm 1 \text{ }^{\circ}\text{C}$	$\pm 0.860 \text{ }^{\circ}\text{C}$
Humidity	$\pm 5 \%$	$\pm 0.740 \%$
DC and Low Frequency Voltages	$\pm 3 \%$	$\pm 0.566 \%$
Time (slower than 10us)	$\pm 5 \%$	$\pm 5.000 \%$
Duty Cycle	$\pm 5 \%$	$\pm 5.000 \%$

The expressed measurement uncertainties shown in the above table have been calculated using a coverage factor of $k=2$ resulting in a confidence level of 95%.

7 TEST RESULTS SUMMARY

Table 7-1 summarizes the results for the tested EUT corresponding with the essential requirements defined in EN 300 328. Table 7-2 summarizes the frequencies evaluated for each essential requirement.

Table 7-1: Test results summary

Harmonized Standard EN 300 328 The following requirements and test specifications are relevant to the presumption of conformity under the article 3.2 of the RE Directive					
Test Parameter	Test plan (Yes/No)	Test Result	Test Specification Reference: Clause No	Test Report Page No.	Comment
RF output power	N	--	5.4.2	--	(1)
Duty Cycle	N	--	5.4.2	--	(1)
Tx-sequence	N	--	5.4.2	--	(1)
Tx-gap	N	--	5.4.2	--	(1)
Medium Utilisation (MU) factor	N	--	5.4.2	--	(1)
Power Spectral Density	N	--	5.4.3	--	(1)
Accumulated Transmit Time	N	--	5.4.4	--	(1)
Minimum Frequency Occupation	N	--	5.4.4	--	(1)
Hopping Sequence	N	--	5.4.4	--	(1)
Hopping Frequency Separation	N	--	5.4.5	--	(1)
Adaptivity	N	--	5.4.6	--	(1)
Occupied Channel Bandwidth	N	--	5.4.7	--	(1)
Transmitter unwanted emissions in the out-of-band domain	N	--	5.4.8	--	(1)
Transmitter unwanted emissions in the spurious domain	Y	PASS	5.4.9	13	
Receiver spurious emissions	N	--	5.4.10	--	(1)
Receiver Blocking	N	--	5.4.11	--	(1)

(1) This test was not under the scope of evaluation. Testing was limited to the radiated spurious emissions on the host device integrating a previously evaluated module.

Table 7-2: Test Frequencies / Results

Test	Frequency (MHz)	Nominal Power (dBm)	Nominal Bandwidth (MHz)	Result
Tx Spurious Emission (BT/BLE)	2402.000	19.0	1.000000	PASS
Tx Spurious Emission (BT/BLE)	2480.000	19.0	1.000000	PASS
Tx Spurious Emission (WLAN)	2412.000	18.0	20.000000	PASS
Tx Spurious Emission (WLAN)	2472.000	18.0	20.000000	PASS

8 TEST RESULTS

8.1 Test Results Details

8.1.1 Transmitter unwanted emissions in the spurious domain

Test Conditions		Test Specification Reference: Clause No	Test Equip. Used with Equip Number	Method
Normal		5.4.9	30, 321, 329, 338, 412, 432, 609, 701, 731, 851	Radiated
Tnom	+23 °C			

SOLIX 15 MSI G2 – Bluetooth Low Energy

DUT Frequency (MHz)	Frequency (MHz)	level (dBm)	Limit (dBm)	Margin (dB)	Antenna Polarity (H/V)	Result
2402.0000	4804.0000	-50.61	-30.00	20.61	H	PASS
2402.0000	4804.0000	-44.21	-30.00	14.21	V	PASS
2402.0000	7206.0000	-46.82	-30.00	16.82	H	PASS
2402.0000	7206.0000	-49.12	-30.00	19.12	V	PASS
2480.0000	4960.0000	-51.10	-30.00	21.10	H	PASS
2480.0000	4960.0000	-51.30	-30.00	21.30	V	PASS
2480.0000	7440.0000	-47.63	-30.00	17.63	H	PASS
2480.0000	7440.0000	-50.03	-30.00	20.03	V	PASS

*NOTE: Some of the emissions detected are results of emanations from the digital device or peripheral circuitry and components. Those emissions determined to be directly related to the digital device or peripheral circuitry and components are not included.

SOLIX 15 MSI G2 – Bluetooth 8-DPSK

DUT Frequency (MHz)	Frequency (MHz)	level (dBm)	Limit (dBm)	Margin (dB)	Antenna Polarity (H/V)	Result
2402.0000	4804.0000	-47.51	-30.00	17.51	H	PASS
2402.0000	4804.0000	-41.71	-30.00	11.71	V	PASS
2402.0000	7206.0000	-40.72	-30.00	10.72	H	PASS
2402.0000	7206.0000	-39.72	-30.00	9.72	V	PASS
2480.0000	4960.0000	-47.10	-30.00	17.10	H	PASS
2480.0000	4960.0000	-48.20	-30.00	18.20	V	PASS
2480.0000	7440.0000	-37.03	-30.00	7.03	H	PASS
2480.0000	7440.0000	-45.13	-30.00	15.13	V	PASS

*NOTE: Some of the emissions detected are results of emanations from the digital device or peripheral circuitry and components. Those emissions determined to be directly related to the digital device or peripheral circuitry and components are not included.

SOLIX 15 MSI G2 – WLAN 802.11b

DUT Frequency (MHz)	Frequency (MHz)	level (dBm)	Limit (dBm)	Margin (dB)	Antenna Polarity (H/V)	Result
2412.0000	4824.0000	-51.46	-30.00	21.46	H	PASS
2412.0000	4824.0000	-49.96	-30.00	19.96	V	PASS
2412.0000	7236.0000	-44.51	-30.00	14.51	H	PASS
2472.0000	4944.0000	-48.76	-30.00	18.76	H	PASS
2472.0000	4944.0000	-53.16	-30.00	23.16	V	PASS
2472.0000	7416.0000	-45.34	-30.00	15.34	H	PASS

*NOTE: Some of the emissions detected are results of emanations from the digital device or peripheral circuitry and components. Those emissions determined to be directly related to the digital device or peripheral circuitry and components are not included.

SOLIX 15 MSI G2 – WLAN 802.11g

DUT Frequency (MHz)	Frequency (MHz)	level (dBm)	Limit (dBm)	Margin (dB)	Antenna Polarity (H/V)	Result
2412.0000	7236.0000	-46.61	-30.00	16.61	H	PASS
2472.0000	7416.0000	-46.24	-30.00	16.24	H	PASS

*NOTE: Some of the emissions detected are results of emanations from the digital device or peripheral circuitry and components. Those emissions determined to be directly related to the digital device or peripheral circuitry and components are not included.

9 TEST SETUP PHOTOGRAPHS

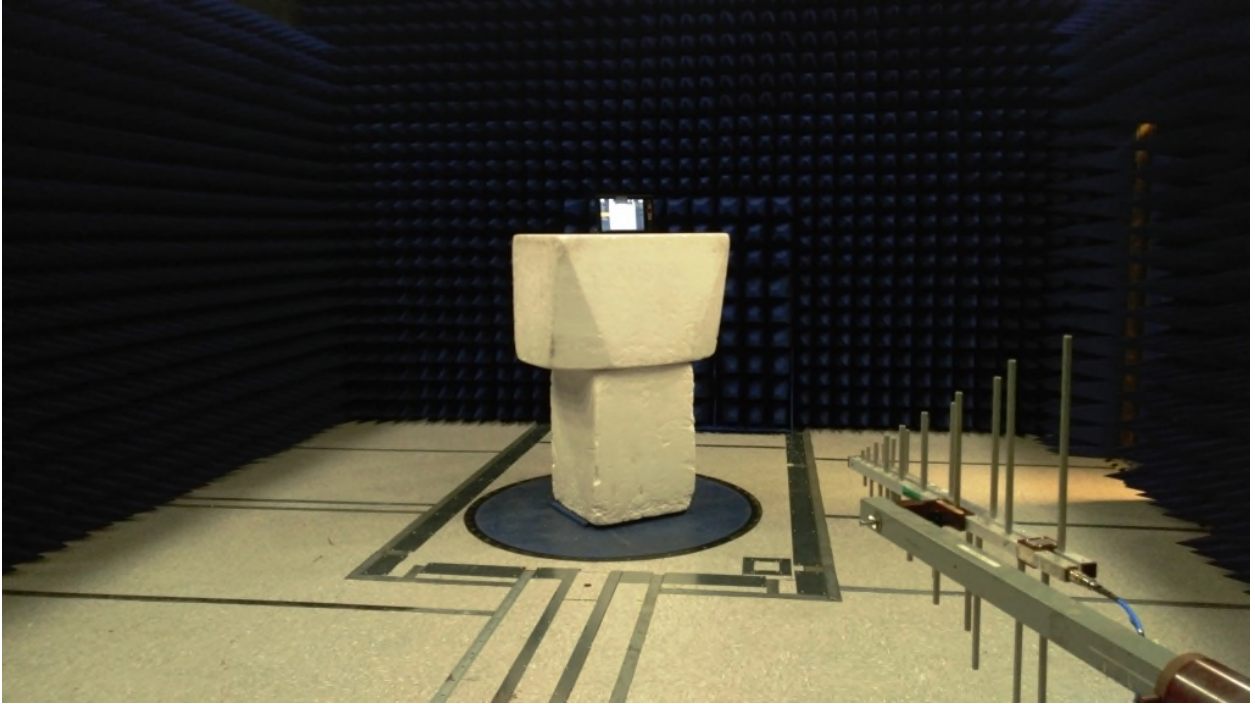


Figure 9-1: Radiated Emissions Test Setup

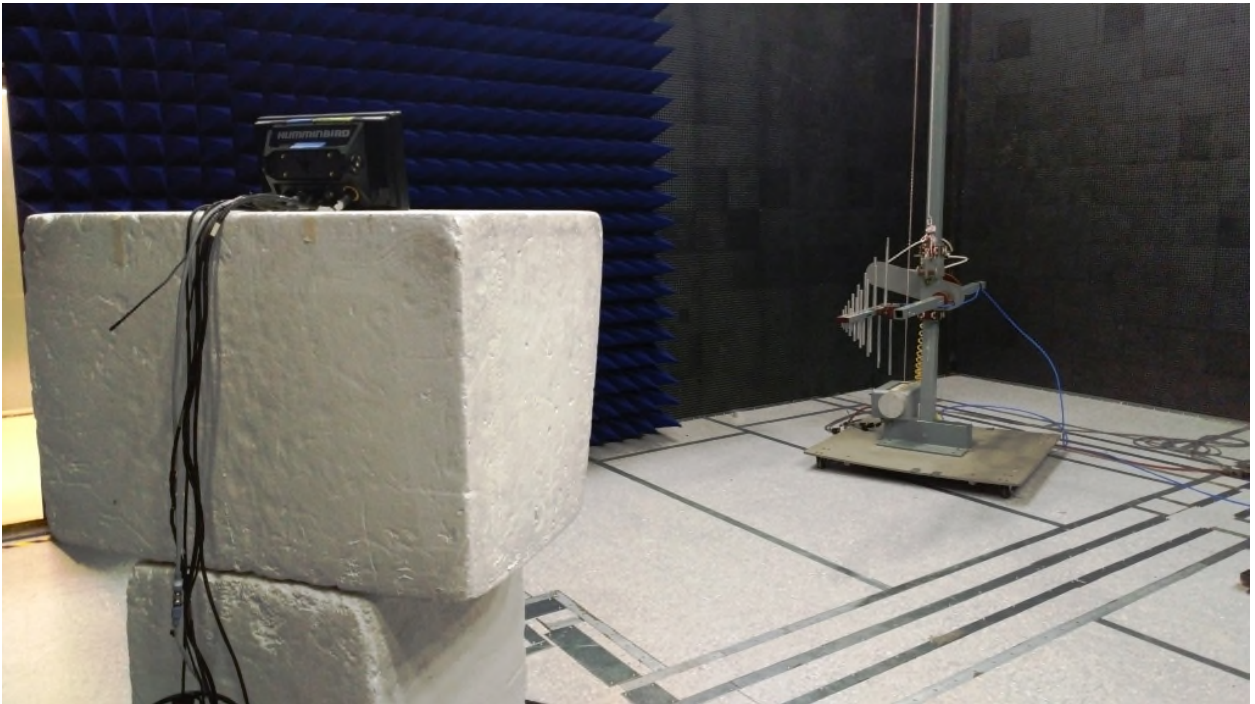


Figure 9-2: Radiated Emissions Test Setup

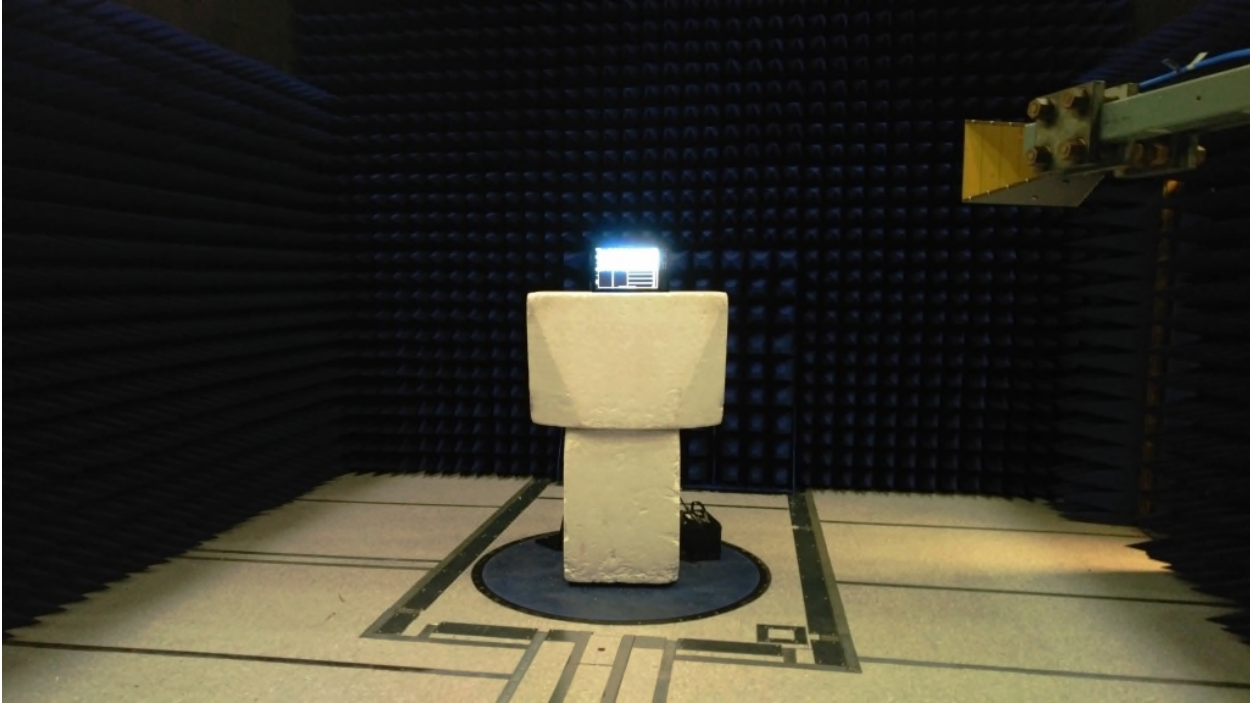


Figure 9-3: Radiated Emissions Test Setup

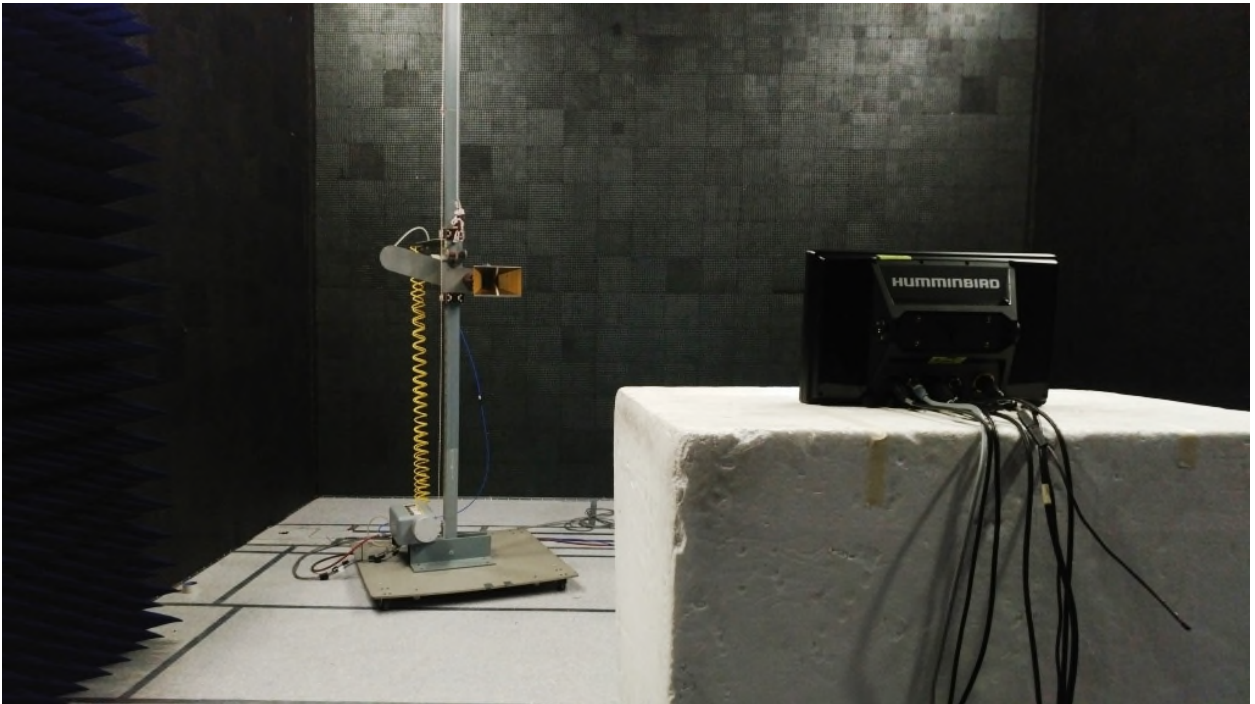


Figure 9-4: Radiated Emissions Test Setup

10 PHOTOGRAPHS OF THE EQUIPMENT (UUT)



Figure 10-1: External Photo



Figure 10-2: External Photo



Figure 10-3: External Photo

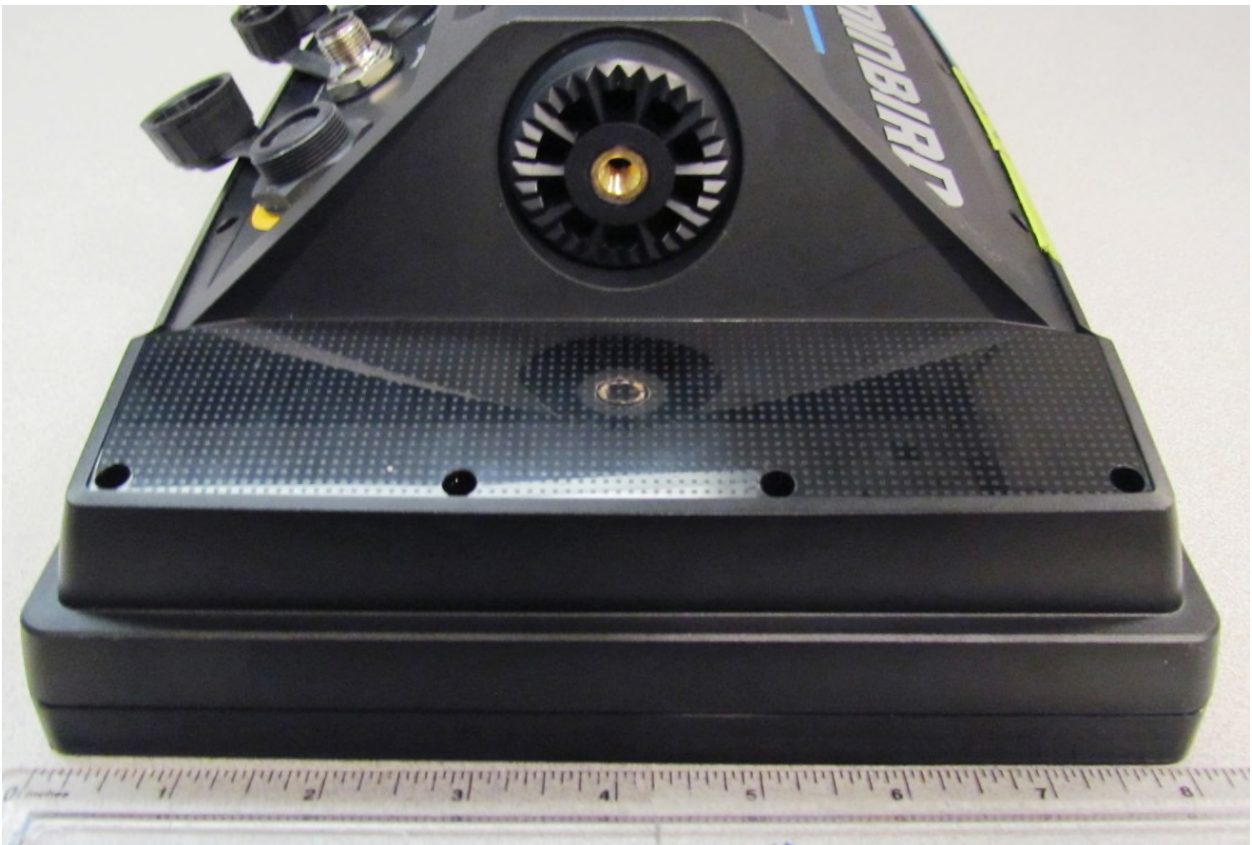


Figure 10-4: External Photo



Figure 10-5: External Photo



Figure 10-6: External Photo

11 TEST EQUIPMENT

The calibration interval of test equipment is annually or the manufacturer's recommendations. Where the calibration interval deviates from the annual cycle based on the instrument manufacturer's recommendations, it shall be stated below.

Table 11-1: Test Equipment

Asset ID	Manufacturer	Model	Equipment Type	Serial Number	Last Calibration Date	Calibration Due Date
30	Spectrum Technologies	DRH-0118	1-18GHz Horn Antenna	970102	05/09/2017	05/09/2019
321	Hewlett Packard	HPC 8447D	Low Freq. Pre-Amp	1937A02809	09/12/2018	09/12/2019
329	A.H.Systems	SAS-571	Horn Antenna	721	08/03/2017	08/03/2019
338	Hewlett Packard	8449B	High Frequency Pre-Amp	3008A01111	07/11/2017	07/11/2019
412	Electro Metrics	LPA-25	Log Periodic Antenna	1241	08/22/2018	08/22/2020
432	Microwave Circuits	H3G020G4	Highpass Filter	264066	05/16/2018	05/16/2019
609	Rohde & Schwarz	SMB100A	Signal Generator (100kHz - 20GHz)	175334	07/12/2018	07/12/2019
701	United Microwave	AA-190-20.00.0	Cable	N/A	07/25/2018	07/25/2019
731	EMCO	3104	Bicon Antenna	2659	11/09/2016	12/09/2018
819	Rohde & Schwarz	ESR26	EMI Test Receiver	101345	11/06/2018	11/06/2019
851	TUV ATLANTA	FMC0101951-100CM	ASAC Cable Set Consisting of 566, 619, and	N/A	09/26/2018	09/26/2019

NCR = No Calibration Required

NOTE: All Equipment only used during active calibration cycles.

END REPORT