



Test Report

**FCC Rule Part: 15.247
ISED Canada Radio Standards Specification: RSS-247**

Report Number: AT72143355-1Z1

Manufacturer: Johnson Outdoors, Inc.
Model: SOLIX 10 MSI G2

Test Begin Date: November 7, 2018
Test End Date: November 28, 2018

Report Issue Date: January 11, 2019



For 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 of the Federal Government.

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This report contains 13 pages

TABLE OF CONTENTS

1	GENERAL	3
1.1	PURPOSE.....	3
1.2	PRODUCT DESCRIPTION	3
1.3	TEST METHODOLOGY AND CONSIDERATIONS	4
2	TEST FACILITIES.....	5
2.1	LOCATION	5
2.2	LABORATORY ACCREDITATIONS/RECOGNITIONS/CERTIFICATIONS	5
2.3	RADIATED EMISSIONS TEST SITE DESCRIPTION	6
2.3.1	<i>Semi-Anechoic Chamber Test Site – Chamber A.....</i>	6
2.3.2	<i>Semi-Anechoic Chamber Test Site – Chamber B.....</i>	7
3	APPLICABLE STANDARD REFERENCES.....	8
4	LIST OF TEST EQUIPMENT.....	8
5	SUPPORT EQUIPMENT	9
6	EQUIPMENT UNDER TEST SETUP BLOCK DIAGRAM	9
7	SUMMARY OF TESTS.....	10
7.1	ANTENNA REQUIREMENT – FCC: PART 15.203.....	10
7.2	EMISSION LEVELS	10
7.2.1	<i>Emissions into Restricted Frequency Bands – FCC: Sections 15.205, 15.209, 15.247(d); ISED Canada: RSS-Gen 8.9 / 8.10.....</i>	10
7.2.1.1	<i>Measurement Procedure.....</i>	10
7.2.2	<i>Test Results</i>	11
7.2.3	<i>Sample Calculation:</i>	12
8	ESTIMATION OF MEASUREMENT UNCERTAINTY	13
9	CONCLUSION	13

1 GENERAL

1.1 Purpose

The purpose of this report is to demonstrate compliance with Part 15 Subpart C of the FCC's Code of Federal Regulations and Innovation, Science and Economic Development Canada's Radio Standards Specification RSS-247 for certification.

1.2 Product description

Product Name: SOLIX 10 MSI G2

The Humminbird SOLIX 10 MSI G2 (411010-1) 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, WiFi/Bluetooth module, and both external NMEA 0183 and NMEA2K devices.

The SOLIX 10 MDI G2 CHO is identical to the SOLIX 10 MSI G2 with the exception of the SW settings that limit sonar to traditional 2D and Down imaging.

Model variants include:

411010-1	SOLIX 10 MSI G2
411090-1CHO	SOLIX 10 MDI G2 CHO

This test report demonstrates continued compliance of the Redpine Bluetooth/WLAN module, FCC ID: XF6-M15SB, when integrated into the SOLIX 10 MSI G2 host device.

Technical Information: Bluetooth (Redpine Module)

Detail	Description
Frequency Range	2402 - 2480 MHz
Number of Channels	BT Classic: 79 BT Low Energy: 40
Modulation Format	GFSK, $\pi/4$ -DQPSK, 8-DPSK
Operating Voltage	3.0-3.6 VDC
Antenna Type / Gain	Surface Mount Ceramic Chip / 0.99 dBi

Technical Information: WLAN (Redpine Module)

Detail	Description
Frequency Range	2412 - 2462 MHz
Number of Channels	802.11b/g/n(HT20): 11 802.11n(HT40): 7
Modulation Format	802.11b: DSSS (DBPSK / DQPSK / CCK) 802.11g/n: OFDM (BPSK / QPSK / 16QAM / 64QAM)
Operating Voltage	3.0-3.6 VDC
Antenna Type / Gain	Surface Mount Ceramic Chip / 0.99 dBi

Manufacturer Information:

Johnson Outdoors, Inc.
678 Humminbird Lane
Eufaula, AL 36027

Test Sample Serial Number(s): 180925220203

Test Sample Condition: The test sample was provided in working order with no visible defects.

1.3 Test Methodology and Considerations

The worst-case modes of operation as defined in the modular test report were evaluated. 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. The data presented in this report represents the worst case where applicable.

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.

The EUT is a DC-powered device with no provisions for connection to the public utilities, therefore power line conducted emissions was not performed.

Software power setting during test:

BT Classic, EDR3/DH5; Channels 0, 39, and 79: 14
Bluetooth LE, 2Mbps; Channel 0: 16
Bluetooth LE, 2Mbps; Channel 19: 16
Bluetooth LE, 2Mbps; Channel 39: 16
WLAN 802.11b, 1Mbps; Channel 1: 22
WLAN 802.11b, 1Mbps; Channel 6: 22
WLAN 802.11b, 1Mbps; Channel 11: 20
WLAN 802.11g, 6Mbps; Channel 1: 18
WLAN 802.11g, 6Mbps; Channel 6: 22
WLAN 802.11g, 6Mbps; Channel 11: 16

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 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.

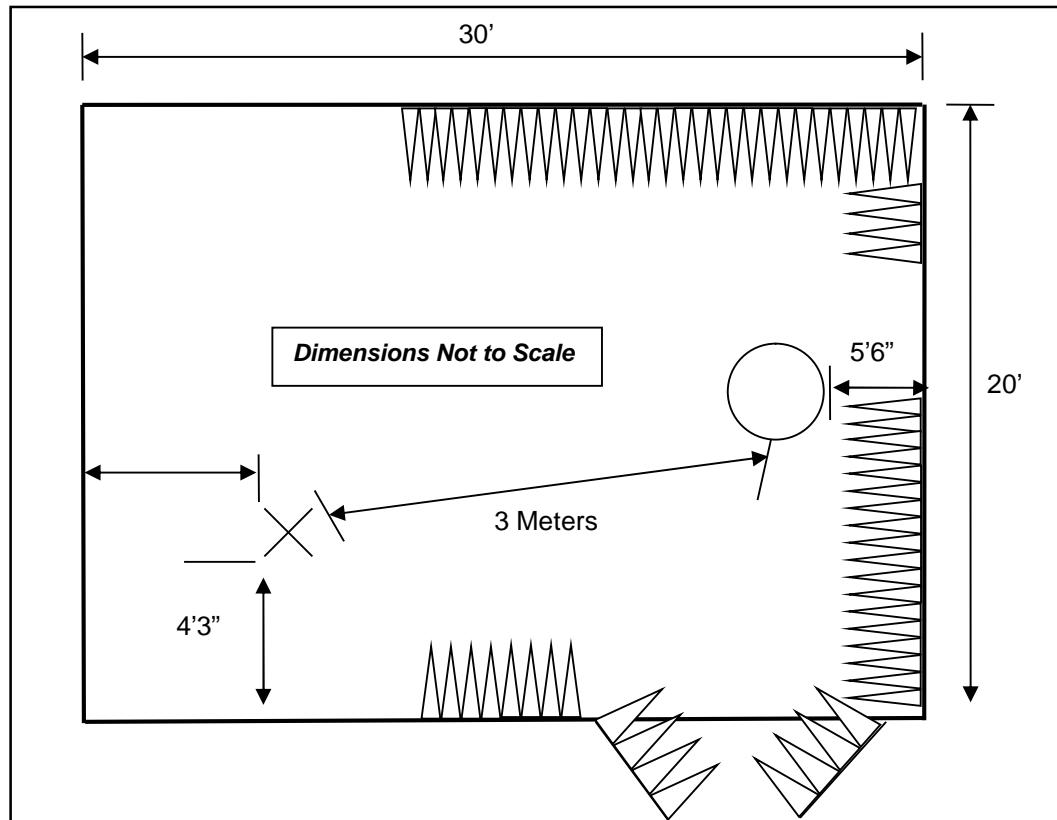


Figure 2.3.1-1: Semi-Anechoic Chamber Test Site – Chamber A

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.

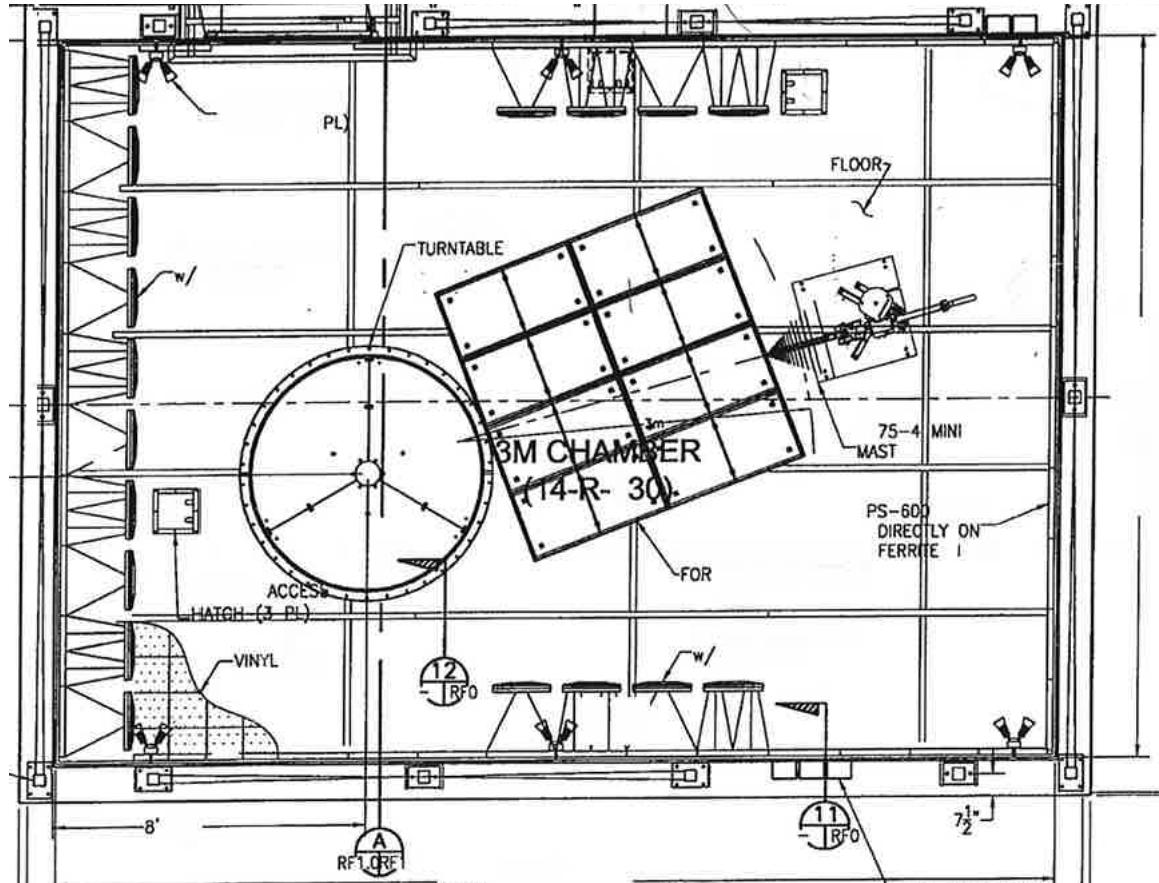


Figure 2.3.2-1: Semi-Anechoic Chamber Test Site – Chamber B

3 APPLICABLE STANDARD REFERENCES

The following standards were used:

- ❖ ANSI C63.10-2013: American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices
- ❖ US Code of Federal Regulations (CFR): Title 47, Part 2, Subpart J: Equipment Authorization Procedures, 2018
- ❖ US Code of Federal Regulations (CFR): Title 47, Part 15, Subpart C: Radio Frequency Devices, Intentional Radiators, 2018
- ❖ ISED Canada Radio Standards Specification: RSS-247 – Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices, Issue 2, February 2017.
- ❖ Innovation, Science and Economic Development Canada Radio Standards Specification: RSS-GEN – General Requirements for Compliance of Radio Apparatus, Issue 5, April 2018.

4 LIST OF 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 4-1: 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
338	Hewlett Packard	8449B	High Frequency Pre-Amp	3008A01111	07/11/2017	07/11/2019
432	Microwave Circuits	H3G020G4	Highpass Filter	264066	05/16/2018	05/16/2019
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 643	N/A	09/26/2018	09/26/2019
852	Teseq	CBL 6112D	Bilog Antenna; Attenuator	51617	10/15/2018	10/15/2019

5 SUPPORT EQUIPMENT

Table 5-1: 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 5-2: 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

6 EQUIPMENT UNDER TEST SETUP BLOCK DIAGRAM

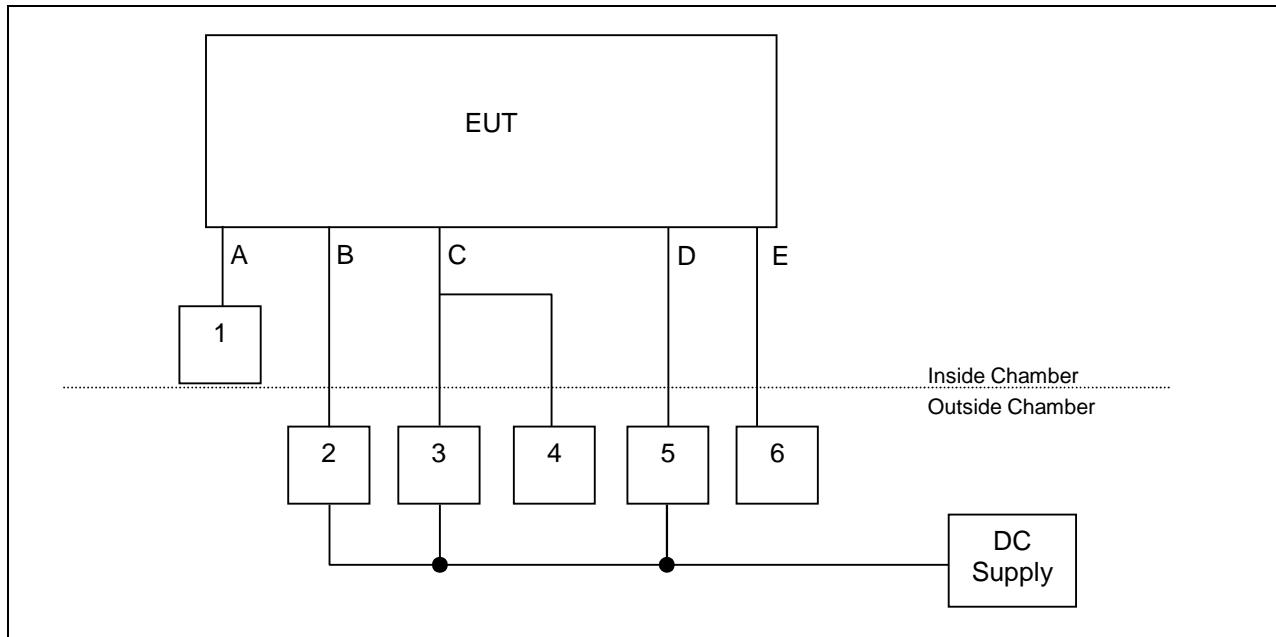


Figure 6-1: EUT System Block Diagram

7 SUMMARY OF TESTS

Along with the tabular data shown below, plots were taken of all signals deemed important enough to document.

7.1 Antenna Requirement – FCC: Part 15.203

The antenna is a Surface Mount Ceramic Chip antenna and is non-detachable without compromising the device, therefore satisfying Part 15.203. The antenna gain is 0.99 dBi.

7.2 Emission Levels

7.2.1 Emissions into Restricted Frequency Bands – FCC: Sections 15.205, 15.209, 15.247(d); ISED Canada: RSS-Gen 8.9 / 8.10

7.2.1.1 Measurement Procedure

Radiated emissions tests were made over the frequency range of 9 kHz to 25 GHz, 10 times the highest fundamental frequency.

Measurements below 30 MHz were performed with a 3 meter separation distance between the EUT and measurement antenna. The EUT was rotated 360° to maximize each emission. The magnetic loop receiving antenna was positioned with its lowest point 1 meter above the ground. The loop antenna was aligned along the site axis, orthogonal to the site axis, and ground-parallel to the site axis.

The spectrum analyzer's resolution and video bandwidths were set to 200 Hz and 1000 Hz respectively for frequencies below 150 kHz and 9 kHz and 30 kHz respectively for frequencies above 150 kHz and below 30 MHz.

For measurements above 30 MHz, the EUT was rotated through 360° and the receive antenna height was varied from 1 meter to 4 meters so that the maximum radiated emissions level would be detected. For frequencies below 1000 MHz, measurements were made using a resolution bandwidth (RBW) of 120 kHz and a video bandwidth (VBW) of 300 kHz. For frequencies above 1000 MHz, measurements were made with RBW of 1 MHz and a VBW of 3 MHz.

Each emission found to be in a restricted band as defined by section 15.205, was compared to the radiated emission limits as defined in section 15.209.

7.2.2 Test Results

Performed by: Tyler Leeson

Radiated spurious emissions are reported in Table 7.2.2-1 through Table 7.2.2-4. Emissions not reported were below the noise floor of the measurement system. There were emissions detected between 30 and 1000MHz, but these were determined by comparison scans to not be related to the radio module and fall under the Subpart B Section 15.109 unintentional emissions requirements.

Table 7.2.2-1: Radiated Emissions – Bluetooth Low Energy

Frequency (MHz)	Level (dBuV)		Antenna Polarity (H/V)	Correction Factors (dB)	Corrected Level (dBuV/m)		Limit (dBuV/m)		Margin (dB)	
	pk	Qpk/Avg			pk	Qpk/Avg	pk	Qpk/Avg	pk	Qpk/Avg
Spurious Emissions										
2390	49.67	38.67	H	-3.90	45.77	34.77	74.0	54.0	28.2	19.2
2390	48.24	37.77	V	-3.90	44.34	33.87	74.0	54.0	29.7	20.1
2483.5	56.82	47.35	H	-3.46	53.36	43.89	74.0	54.0	20.6	10.1
2483.5	53.71	44.78	V	-3.46	50.25	41.32	74.0	54.0	23.7	12.7
4880	51.50	43.15	H	4.82	56.32	47.97	74.0	54.0	17.7	6.0
4880	51.63	43.45	V	4.82	56.45	48.27	74.0	54.0	17.6	5.7
7320	50.04	40.97	H	10.46	60.50	51.43	74.0	54.0	13.5	2.6
7320	49.27	38.98	V	10.46	59.73	49.44	74.0	54.0	14.3	4.6

Table 7.2.2-2: Radiated Emissions – Bluetooth EDR-3 / DH5

Frequency (MHz)	Level (dBuV)		Antenna Polarity (H/V)	Correction Factors (dB)	Corrected Level (dBuV/m)		Limit (dBuV/m)		Margin (dB)	
	pk	Qpk/Avg			pk	Qpk/Avg	pk	Qpk/Avg	pk	Qpk/Avg
Spurious Emissions										
2390	46.08	35.34	H	-3.90	42.18	31.44	74.0	54.0	31.8	22.6
2390	44.65	34.28	V	-3.90	40.75	30.38	74.0	54.0	33.2	23.6
2483.5	50.52	42.71	H	-3.46	47.06	39.25	74.0	54.0	26.9	14.7
2483.5	50.01	41.20	V	-3.46	46.55	37.74	74.0	54.0	27.4	16.3
4804	52.16	45.97	H	4.51	56.67	50.48	74.0	54.0	17.3	3.5
4804	50.76	44.15	V	4.51	55.27	48.66	74.0	54.0	18.7	5.3

Table 7.2.2-3: Radiated Emissions – WLAN 802.11b, 1Mbps

Frequency (MHz)	Level (dBuV)		Antenna Polarity (H/V)	Correction Factors (dB)	Corrected Level (dBuV/m)		Limit (dBuV/m)		Margin (dB)	
	pk	Qpk/Avg			pk	Qpk/Avg	pk	Qpk/Avg	pk	Qpk/Avg
Spurious Emissions										
2390	45.54	33.51	H	-3.90	41.64	29.61	74.0	54.0	32.4	24.4
2390	44.73	33.01	V	-3.90	40.83	29.11	74.0	54.0	33.2	24.9
2483.5	44.43	33.13	H	-3.46	40.97	29.67	74.0	54.0	33.0	24.3
2483.5	44.04	32.89	V	-3.46	40.58	29.43	74.0	54.0	33.4	24.6
4874	49.54	42.80	H	4.44	53.98	47.24	74.0	54.0	20.0	6.8
4874	51.24	42.85	V	4.44	55.68	47.29	74.0	54.0	18.3	6.7
7311	45.68	34.95	H	10.13	55.81	45.08	74.0	54.0	18.2	8.9

Table 7.2.2-4: Radiated Emissions – WLAN 802.11g, 6Mbps

Frequency (MHz)	Level (dBuV)		Antenna Polarity (H/V)	Correction Factors (dB)	Corrected Level (dBuV/m)		Limit (dBuV/m)		Margin (dB)	
	pk	Qpk/Avg			pk	Qpk/Avg	pk	Qpk/Avg	pk	Qpk/Avg
Spurious Emissions										
2390	51.12	37.52	H	-3.90	47.22	33.62	74.0	54.0	26.8	20.4
2390	46.91	34.51	V	-3.90	43.01	30.61	74.0	54.0	31.0	23.4
2483.5	58.09	42.87	H	-3.46	54.63	39.41	74.0	54.0	19.4	14.6
2483.5	54.88	40.21	V	-3.46	51.42	36.75	74.0	54.0	22.6	17.2
4874	45.58	34.67	H	4.79	50.37	39.46	74.0	54.0	23.6	14.5
7311	45.90	33.38	H	10.45	56.35	43.83	74.0	54.0	17.6	10.2

7.2.3 Sample Calculation:

$$R_C = R_U + C F_T$$

Where:

$C F_T$ = Total Correction Factor (AF+CA+AG)-DC (Average Measurements Only)

R_U = Uncorrected Reading

R_C = Corrected Level

AF = Antenna Factor

CA = Cable Attenuation

AG = Amplifier Gain

DC = Duty Cycle Correction Factor

Example Calculation: Peak – Bluetooth LE – 7320MHz – Horizontal polarity

Corrected Level: $50.04 + 10.46 = 60.50$ dBuV

Margin: 74 dBuV – 60.50 dBuV = 13.5 dB

Example Calculation: Average – Bluetooth LE – 7320MHz – Horizontal polarity

Corrected Level: $40.97 + 10.46 = 51.43$ dBuV

Margin: 54 dBuV – 51.43 dBuV = 2.6 dB

8 ESTIMATION OF MEASUREMENT UNCERTAINTY

The expanded laboratory measurement uncertainty figures (U_{Lab}) provided below correspond to an expansion factor (coverage factor) $k = 1.96$ which provide confidence levels of 95%.

Table 8-1: Estimation of Measurement Uncertainty

Parameter	U_{Lab}
Occupied Channel Bandwidth	$\pm 0.009 \%$
RF Conducted Output Power	$\pm 0.349 \text{ dB}$
Power Spectral Density	$\pm 0.372 \text{ dB}$
Antenna Port Conducted Emissions	$\pm 1.264 \text{ dB}$
Radiated Emissions $\leq 1 \text{ GHz}$	$\pm 5.814 \text{ dB}$
Radiated Emissions $> 1 \text{ GHz}$	$\pm 4.318 \text{ dB}$
Temperature	$\pm 0.860 \text{ }^{\circ}\text{C}$
Radio Frequency	$\pm 2.832 \times 10^{-8}$
AC Power Line Conducted Emissions	$\pm 3.360 \text{ dB}$

9 CONCLUSION

In the opinion of TÜV SÜD America Inc. the SOLIX 10 MSI G2 manufactured by Johnson Outdoors, Inc met the requirements of FCC Part 15 subpart C and Innovation, Science and Economic Development Canada's Radio Standards Specification RSS-247 for the tests documented herein.

END REPORT