
Project 17650A-15

**OMNI V001
2.4 GHz Aggregator
Gazell Radio Section**

Wireless Certification Report

Prepared for:

Virtuix
1826 Kramer Lane, Suite H
Austin, TX 78758

By

Professional Testing (EMI), Inc.
1601 North A.W. Grimes Blvd., Suite B
Round Rock, Texas 78665

21 Mar 2016

Reviewed by

A handwritten signature in black ink, appearing to read 'Larry Finn'.

Larry Finn
Chief Technical Officer

Written by

A handwritten signature in black ink, appearing to read 'Eric Lifsey'.

Eric Lifsey
EMC Engineer

Revision History

Revision Number	Description	Date
00	Draft Release for review.	25 Feb 2016
01	Revised per reviewer comments.	29 Feb 2016
02	Revised and final.	21 Mar 2016

Corrections:

The name Brian Olinger is correctly spelled as Bryan Olinger.

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Certificate of Compliance

Applicant	Device & Test Identification
Virtuix, Inc. (Doug Shuffield) 1826 Kramer Lane, Suite H Austin, TX 78758 Certificate Date: 21 Mar 2016	FCC ID: 2AHFN-OMNIV001 Industry Canada ID: 21168-OMNIV001 Model(s): OMNI V001 Laboratory Project ID: 17650A-15

The device model(s) listed above were tested utilizing the following documents and found to be in compliance with the required criteria.

Requirement**	Reference	Detail
FCC 47 CFR Part 15 C	15.247	Operation within the bands 902-928 MHz, <u>2400-2483.5 MHz</u> , and 5725-5850 MHz.
FCC 47 CFR Part 15 C	15.209	Radiated emission limits; general requirements.
FCC 47 CFR Part 15 C	15.207	Conducted emission limits.
FCC 47 CFR Part 15 C	15.205	Restricted Bands of Operation
KDB 558074 D01	DR01	DTS Measurement Guidance v03r02
KDB 412172	D01	Guidelines for Determining the ERP and EIRP of an RF Transmitting System
OET Bulletin 65*	Edition 97-01, and Supplement C, Ed. 01-01	Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields
RSS-247	Issue 1	Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices
RSS-Gen	Issue 4	General Requirements and Information for the Certification of Radio Apparatus
RSS-102	Issue 4	Radio Frequency (RF) Exposure Compliance of Radiocommunication Apparatus (All Frequency Bands)

*MPE is reported separately from this document. **Corresponding RSS references are listed in the body of the report.

I, Eric Lifsey, for Professional Testing (EMI), Inc., being familiar with the above requirements have reviewed the test setup, measured data, and this report. I believe them to be true and accurate.

Eric Lifsey
EMC Engineer

This report has been reviewed and accepted by the Applicant. The undersigned is responsible for ensuring that this device will continue to comply with the requirements listed above.

Representative of Applicant

1.0 Introduction

1.1 Scope

This report describes the extent to which the equipment under test (EUT) conformed to the intentional radiator requirements of the United States and Canada.

Professional Testing (EMI), Inc., (PTI) follows the guidelines of National Institute of Standards and Technology (NIST) for all uncertainty calculations, estimates, and expressions thereof for electromagnetic compatibility testing.

1.2 EUT Description

The EUT is a part of a virtual reality system and known on the design level as Gazell. This radio is part of a board with a fixed location in a large floor-mounted base. The board contains two functional radios; Gazell, and the other is a Bluetooth radio. This radio takes wireless reports of user foot movement data from remote POD radios. The Bluetooth radio test results are reported separately.

Table 1.2.1: Equipment Under Test		
Manufacturer / Model	Serial #	Description
Virtuix, Inc. OMNI V001	None	2400-2483.5 MHz transceiver for collecting data from POD devices.

The device employs a chip antenna. The EUT board is powered from the mains by a wall-wart style power supply with 12 VDC output. The circuit board which comprises the bulk of the system measures approximately 10 x 9 cm.

The overall OMNI system measures approximately 1.2 x 1.2 x 1.1 m and consists of a shallow bowl-like platform and a semi-rigid torso retainer. In normal operation the user occupies the center and is loosely restrained such that movement of torso/legs/feet is allowed though the person does not leave the platform. The OMNI collects user position data of torso using internal hall effect sensors and feet by communication with the POD device on each shoe.

1.3 EUT Operation

The EUT was exercised in a manner consistent with normal operations.

1.4 Modifications to Equipment

No internal/radio modifications were made to the EUT during the performance of the test program. During the test external ferrites were added to USB and DC power cables to suppress radiated broadband switching noise.

- | |
|--|
| 1. Ferrite added to USB cable, Laird 23A0434-0A2 |
| 2. Ferrite added to power cable, Laird 28A0392-0A2 |

1.5 Test Site

Measurements were made at the PTI semi-anechoic facility designated Site 45 (FCC 459644, IC 3036B-1) in Austin, Texas. The site is registered with the FCC under Section 2.948 and Industry Canada per RSS-GEN, and is subsequently confirmed by laboratory accreditation (NVLAP). The test site is located

at 11400 Burnet Road, Austin, Texas 78758, while the main office is located at 1601 North A.W. Grimes Boulevard, Suite B, Round Rock, Texas, 78665.

1.6 Radiated Measurements

Radiated levels are determined as follows:

$$\text{Raw Measured Level} + \text{Antenna Factor} + \text{Cable Losses} - \text{Amplifier Gain} = \text{Corrected Level}$$

Conducted RF levels are determined as follows:

$$\text{Raw Measured Level} + \text{Attenuator Factor} + \text{Cable Losses} = \text{Corrected Level}$$

Conducted mains levels are determined as follows:

$$\text{Raw Measured Level} + \text{LISN Factor} + \text{Cable/Filter/Limiter Losses} = \text{Corrected Level}$$

Additionally, measurement distance extrapolation factors are applied and documented where used.

1.7 Applicable Documents and Clauses

Table 1.7.1: Applicable Documents

Document	Title
47 CFR	Part 15 – Radio Frequency Devices Subpart C -Intentional Radiators
RSS-247 Issue 1	Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices
RSS-Gen Issue 4	General Requirements and Information for the Certification of Radio Apparatus
ANSI C63.4 2009	American National Standard for Methods of Measurement of Radio-Noise Emissions from Low Voltage Electrical and Electronic Equipment

Table 1.7.2: Applicable Clauses

Parameter	FCC Part 15 Rule Paragraphs	IC RSS References
Transmitter Characteristics	15.247(a)(2)	RSS-247 5.2 (DTS) & 5.4, RSS-Gen 6
Power Spectral Density	15.247(e)	RSS-247 5.2 (DTS)
Bandwidth	15.247(a)(2), 2.1049, KDB 558074 D01	RSS-247 5.2 (DTS), RSS-Gen 6.6
Spurious Emission	15.247, 15.209, 15.205	RSS-247 5.5, RSS-GEN 6.13, 7.1
Band Edge	15.247, 15.205	RSS-247 5.5, RSS-Gen 6.13
Antenna Requirement	15.203	RSS-Gen 8.3
Conducted Emissions, Mains	15.207	RSS-Gen 8.8

2.0 Fundamental Power

2.1 Test Procedure

Bandwidth is first determined to select correct entire bandwidth for power measurement and the fundamental field strength is then measured.

2.2 Test Criteria

47 CFR (USA) // IC (Canada)		
Section Reference	Parameter	Date
15.247(a)(2) // RSS-247 5.2	Fundamental Power Conducted Limit: 1 Watt Desired Power Limit: 10 mW Restated as Radiated Limit @ 3 m: 105.23 dB μ V/m	25 Jan 2016

2.3 Test Results

Maximum polarity as indicated. This device is floor-mounted.

Table 2.3.1 Radiated Power at 3 meters, Maximum Polarity		
Frequency MHz	Measured Radiated Peak Power dB μ V/m @ 3m	Maximum Polarity
2402	94.7	H
2441	98.5	H
2481	97.1	V

Measured in 3 MHz RBW, 3 MHz VBW.

The EUT satisfied the requirement. Plotted measurements appear below.

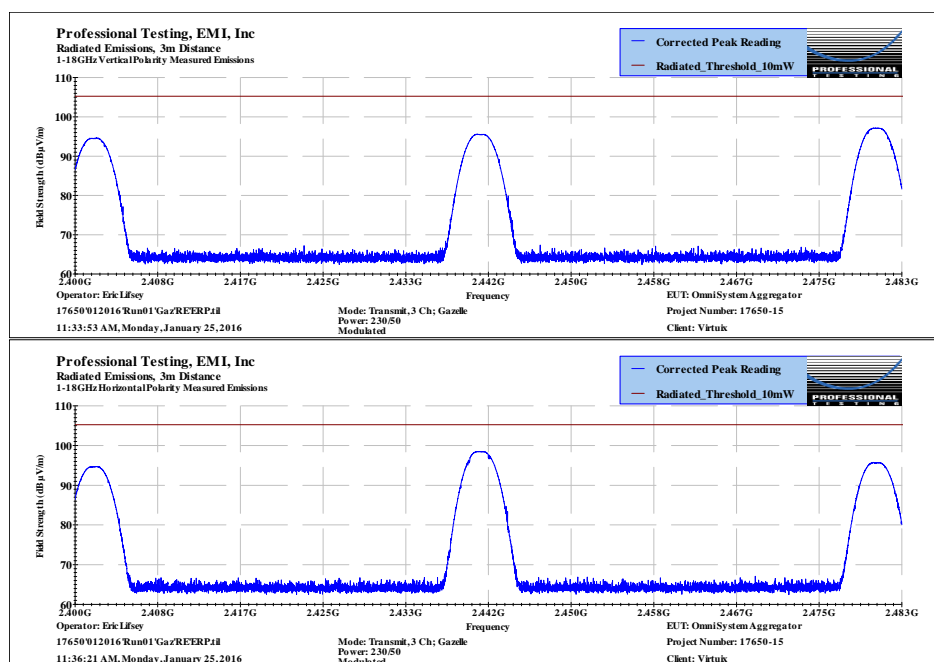


Table 2.3.2 Summary of All Power Measurements		
Frequency MHz	Polarity of Measurement	Measured Radiated Peak Power dB μ V/m @ 3m
2401	H	94.7
2401	V	94.6
2441	H	98.5
2441	V	95.6
2481	H	95.7
2481	V	97.1

3.0 Power Spectral Density

3.1 Test Procedure

The EUT fundamental field strength is measured a spectrum analyzer and is then adjusted to record in max-hold mode for an extended time sufficient to capture all transmit products.

3.2 Test Criteria

47 CFR (USA) // IC (Canada)		
Section Reference	Parameter	Date
15.247(e) // RSS-247 5.2	Power Spectral Density Conducted Limit: 8 dBm / 3 kHz Restated as Radiated Limit @ 3 m: 103.23 dBμV/m	25 Jan 2016

3.3 Test Results

The fundamental peak power in 3 MHz measured to be below the PSD power limit. Therefore EUT satisfied the PSD limit without need for measurement.

4.0 Transmitter Duty Cycle

4.1 Test Procedure

EUT is placed into worse-case transmit operation to observe and record transmitter time domain performance.

4.2 Test Criteria

Section Reference	Parameter	Date(s)
15.247 // RSS-247, RSS-Gen 6.10	Transmit Duty Cycle	26 Jan 2016

Measurement is based on intervals not to exceed 100 msec. Maximum transmitter on time is divided by the lesser of 100 msec or the actual measured minimum transmitter interval time. The result is converted to dB and applied as needed to peak measurements of transmitter artifacts to determine average power. This is not a pass/fail measurement.

4.3 Test Results

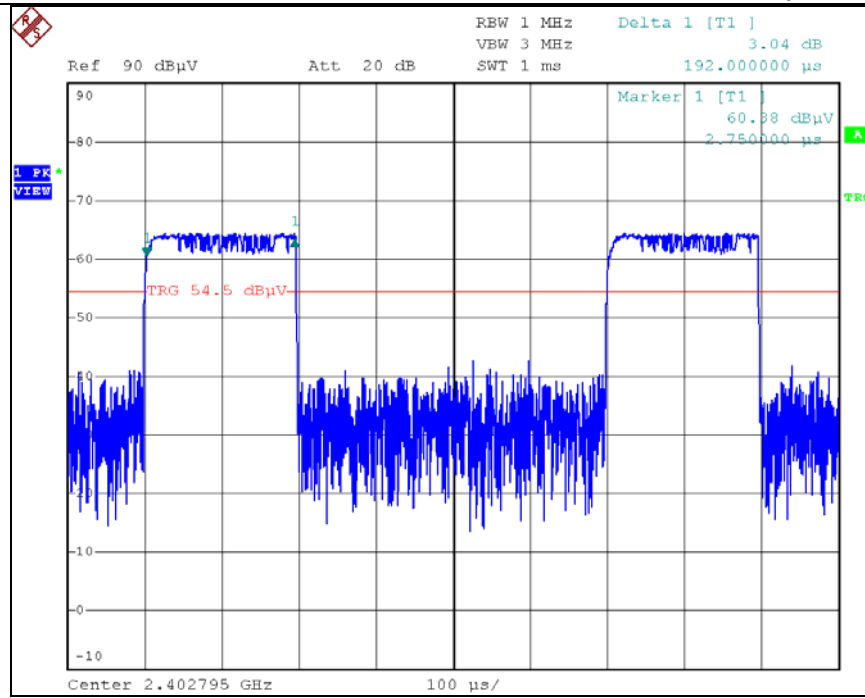
Table 4.3.1 Duty Cycle Factor Result				
Measured On Time (msec)	Measured Time Period (msec)	Duty Cycle Factor Calculation	Result (dB)	Duty Cycle Factor Allowed (dB)
0.384*	3.597	$20 * \log_{10} (0.384 \text{ msec} / 3.597 \text{ msec}) =$	-19.41	-19.41

*Paired transmit events, each 192 ms long, were summed then the period as measured for the paired transmissions.

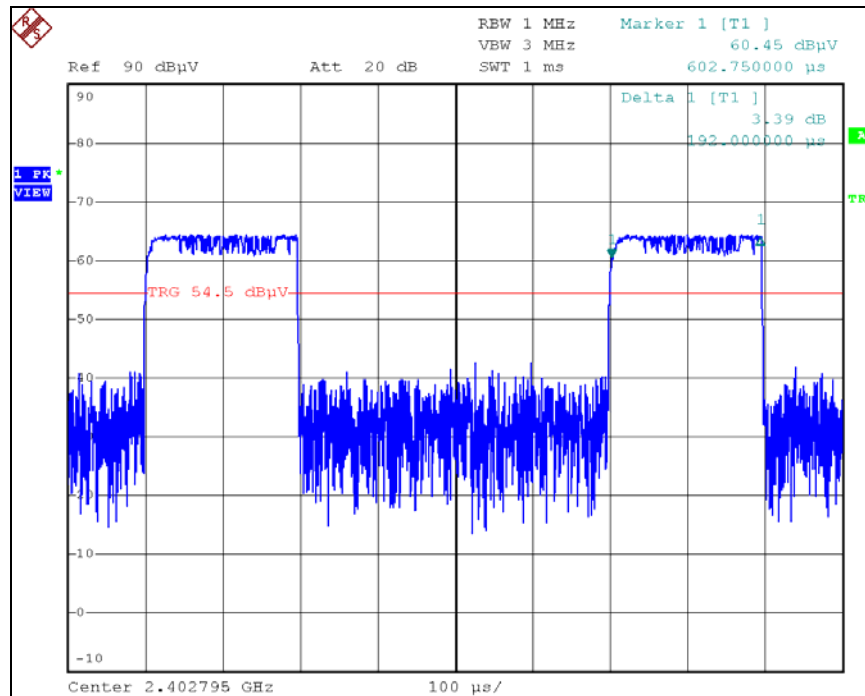
The allowed duty cycle factor is applied to peak measured harmonic signals to find average levels.

The source based factor for exposure is half of the above or: -9.7 dB

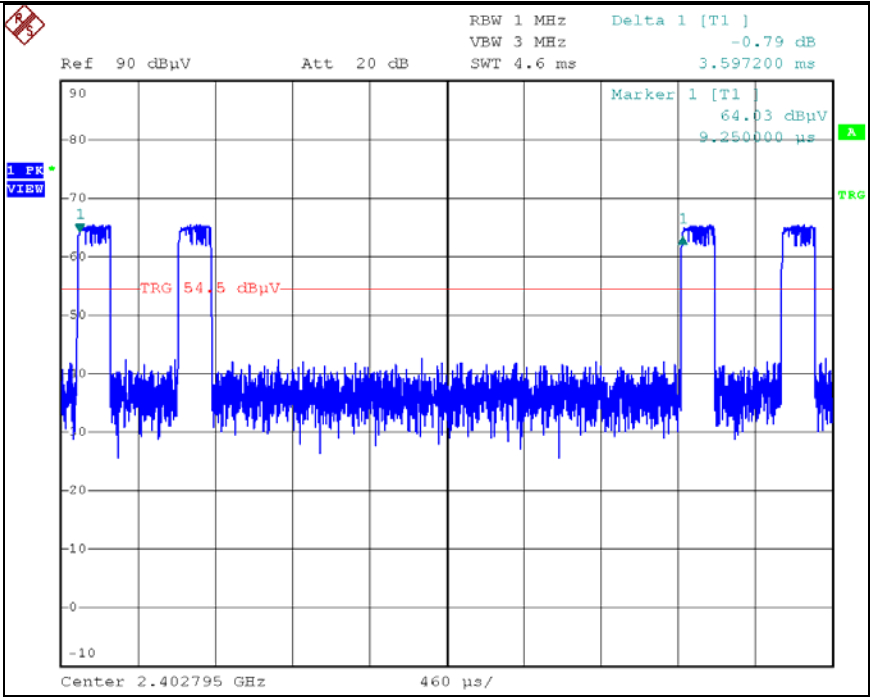
Plotted results appear below.



Two Transmit Events: Measurement of 1st Event = 0.192 ms



Two Transmit Events: Measurement of 2nd Event = 0.192 ms



Time Period

5.0 Occupied Bandwidth

5.1 Test Procedure

The EUT is directly connected to a spectrum analyzer and bandwidth then is measured. A recording of the results is included.

5.2 Test Criteria

47 CFR (USA) // IC (Canada)		
Section Reference	Parameter	Date(s)
14.247(a)(2), 2.1049 // RSS-Gen 5.2, RSS-Gen 6.6	Bandwidth 6 dB, 20 dB	21 Jan 2016

5.3 Test Results

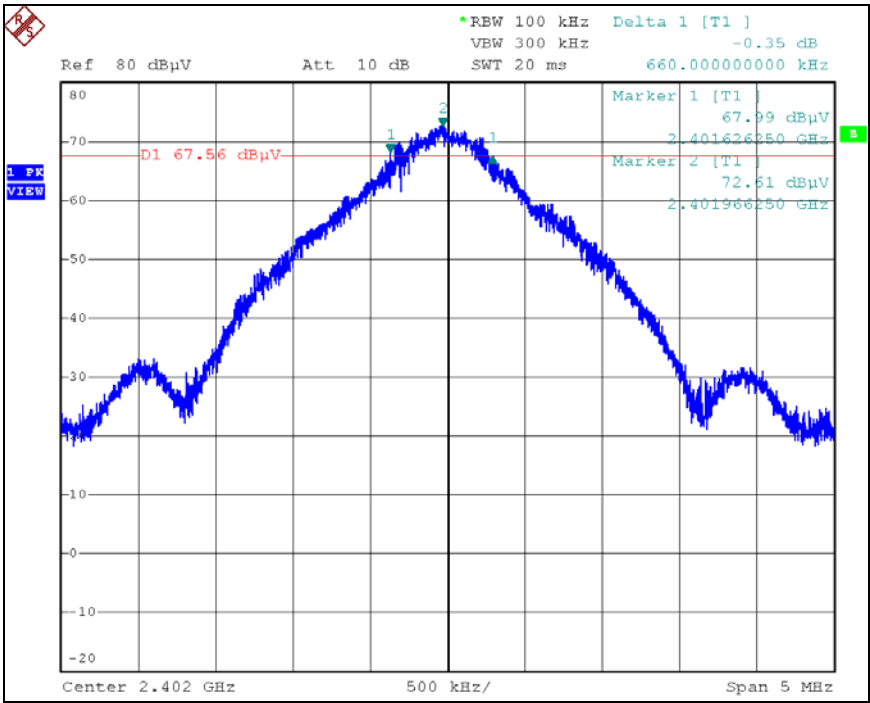
EUT was found to be in compliance with applicable requirements.

Table 5.3.1 Bandwidth 6 dB, Minimum 500 kHz			
Low Channel Measured BW (kHz)	Mid Channel Measured BW (kHz)	High Channel Measured BW (kHz)	Minimum BW (kHz)
660	810	801.3	660

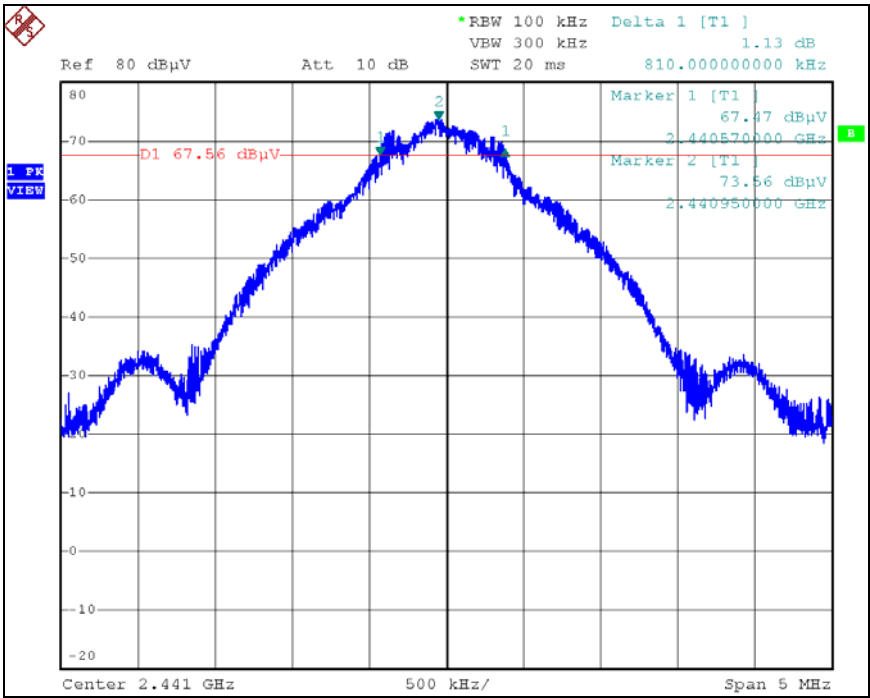
Table 5.3.2 Bandwidth 20 dB, Measure and Report			
Low Channel Measured BW (kHz)	Mid Channel Measured BW (kHz)	High Channel Measured BW (kHz)	Reported Maximum BW (kHz)
1494	1570	1581	1581

Plotted measurements appear on the following pages.

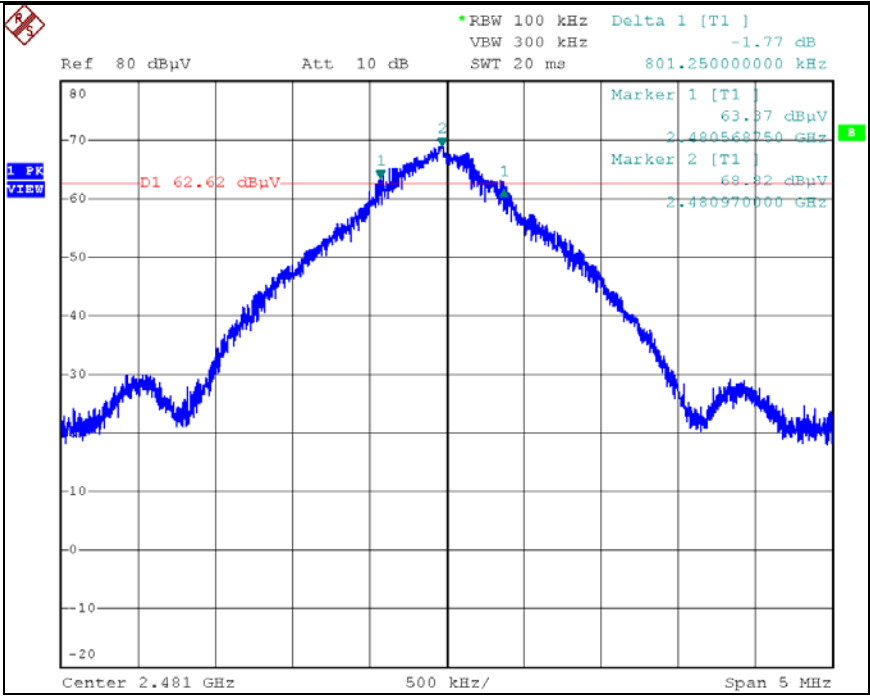
5.3.1 Bandwidth Plots, 6 dB



6 dB, Low Channel

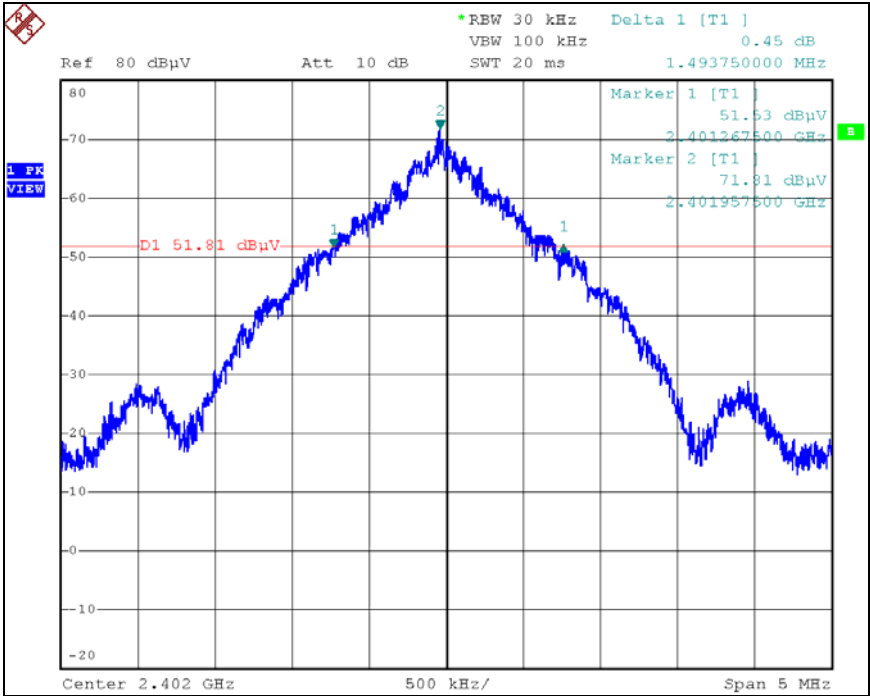


6 dB, Middle Channel

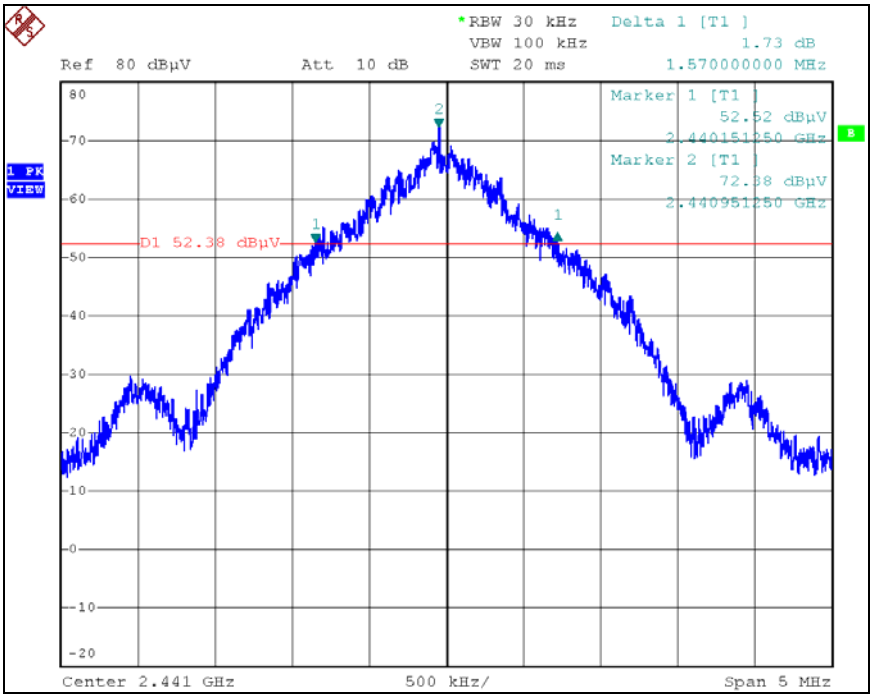


6 dB, High Channel

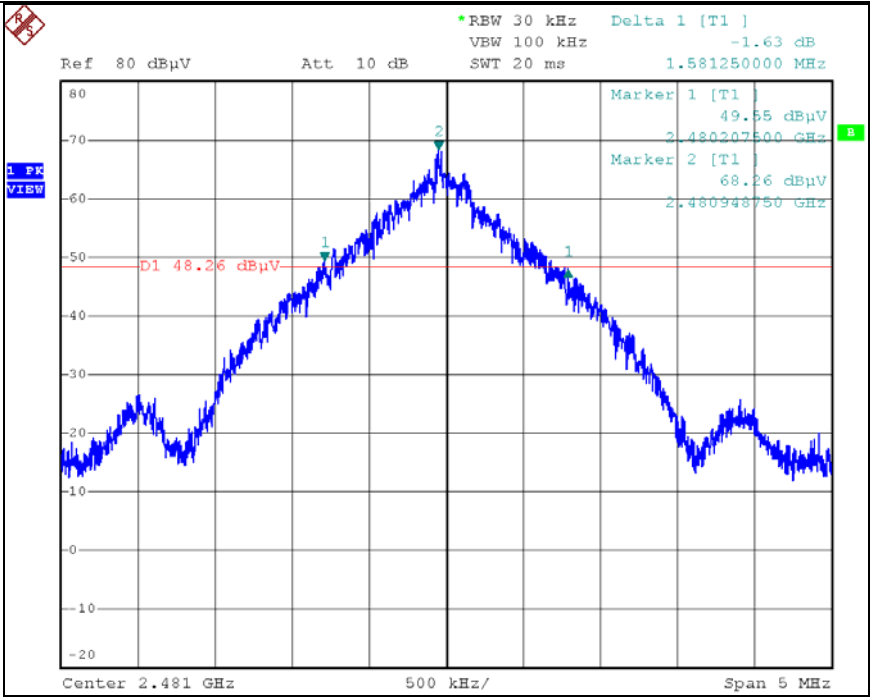
5.3.2 Bandwidth Plots, 20 dB



20 dB, Low Channel



20 dB, Middle Channel



6.0 Band Edge

6.1 Test Procedure

The EUT was placed on a non-conductive table 0.8 meters above the ground plane. The table was centered on a rotating turntable at a distance of 3 meters from the measurement antenna.

EUT is placed into normal transmit operation on the nearest band edge channel. The spectrum analyzer is centered on the band edge frequency with span sufficient to include the peak of the adjacent fundamental signal. Using peak detection, the analyzer measured emissions in max-hold mode. The measurement range includes two standard bandwidths from the respective band edge and some beyond to see the emission profile clearly. If required, the band-edge marker-delta method of C63.4 is utilized.

6.2 Test Criteria

47 CFR (USA) // IC (Canada)		
Section Reference	Parameter	Date(s)
15.205, 15.209 // RSS-247 5.5, RSS-Gen 6.13	Unwanted Emissions Adjacent to Authorized Band, Radiated	25 Jan 2016

6.3 Test Results

The measurement was in the worse-case polarization for the high channel; the same polarization used for the low channel where the difference in polarization was only 0.1 dB (per Table 2.3.2).

Peak detection emissions at band edges were below the applicable general emission peak limits or the -20 dBc limit. (Note that the green limit line is for an unrelated limit for Europe.)

The EUT satisfied the requirements.

6.3.1 Low Channel Band Edge

Professional Testing, EMI, Inc.									
Test Method:		ANSI C63.4–2003: “Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz” (incorporated by reference, see §15.38).							
In accordance with:		FCC Part 15.209 - Code of Federal Regulations Part 47, Subpart C - Intentional Radiators, Radiated Emissions Limits							
Section:		15.209							
Test Date(s):		1/25/2016		EUT Serial #:		NA			
Customer:		Virtuix		EUT Part #:		NA			
Project Number:		17650-15		Test Technician:		Eric Lifsey			
Purchase Order #:		NA		Supervisor:		Lisa Arndt			
Equip. Under Test:		Omni System Aggregator		Witness' Name:		Bryan Olinger			
Radiated Emissions Test Results Data Sheet									
Page: 1 of 1									
EUT Line Voltage:		230 VAC		EUT Power Frequency:		50 Hz			
Antenna Orientation:		Vertical		Frequency Range:		Above 1GHz			
EUT Side Position; Mode of Operation:				Transmit Mode, Modulated, 3 Channels/EUTs					
Frequency Measured (MHz)	Test Distance (Meters)	EUT Direction (Degrees)	Antenna Height (Meters)	Detector Function	Recorded Amplitude (dBμV)	Corrected Level (dBμV/m)	Limit Level (dBμV/m)	Margin (dB)	Test Results
2397.51	3	41	1	Peak	64.6	55.903	74.0	-18.1	Pass
2397.51	3	41	1	Average	38.2	29.586	54.0	-24.4	Pass

Professional Testing, EMI, Inc
Radiated Emissions, 3m Distance
1-18GHz Vertical Polarity Measured Emissions

Corrected Average Reading
Corrected Peak Reading
LIM Y Class B Peak
LIM Y Class B OP AVG
ETSI Transmit Spurious
Band Edge Low

Operator: Eric Lifsey
17650\012016\Run01\RE\GazTxBandEdgeMask\Lower.tif
10:52:31 AM, Monday, January 25, 2016

Mode: Transmit, 2 Ch; low/high; Gazelle
Power: 230/50
Modulated; band-edge and OOB domain

EUT: OmniSystem Aggregator
Project Number: 17650-15
Client: Virtuix

Band Edge, Lower

EUT Satisfies -20 dBc Criteria

6.3.2 High Channel Band Edge

Professional Testing, EMI, Inc.										
Test Method:		ANSI C63.4–2003: “Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz” (incorporated by reference, see §15.38).								
In accordance with:		FCC Part 15.209 - Code of Federal Regulations Part 47, Subpart C - Intentional Radiators, Radiated Emissions Limits								
Section:		15.209								
Test Date(s):		1/25/2016			EUT Serial #:		NA			
Customer:		Virtuix			EUT Part #:		NA			
Project Number:		17650-15			Test Technician:		Eric Lifsey			
Purchase Order #:		NA			Supervisor:		Lisa Arndt			
Equip. Under Test:		Omni System Aggregator			Witness' Name:		Bryan Olinger			
Radiated Emissions Test Results Data Sheet							Page: 1 of 1			
EUT Line Voltage:		230		VAC		EUT Power Frequency:		50		Hz
Antenna Orientation:		Vertical			Frequency Range:		Above 1GHz			
EUT Side Position; Mode of Operation:					Transmit Mode, Modulated, 3 Channels/EUTs					
Frequency Measured (MHz)	Test Distance (Meters)	EUT Direction (Degrees)	Antenna Height (Meters)	Detector Function	Recorded Amplitude (dBμV)	Corrected Level (dBμV/m)	Limit Level (dBμV/m)	Margin (dB)	Test Results	
2484.12	3	193	1	Peak	59	50.674	74.0	-23.3	Pass	
2484.12	3	193	1	Average	43	34.634	54.0	-19.3	Pass	

Professional Testing, EMI, Inc

Radiated Emissions, 3m Distance

1-18GHz Vertical Polarity Measured Emissions

Corrected Average Reading

Corrected Peak Reading

LM-Y Class B OP Peak

LM-Y Class B OP AVG

ETSI Transmit Spurious

Band Edge Low

Band Edge High

PROFESSIONAL TESTING

Field Strength (dB μV/m)

<

Band Edge, Upper

EUT Satisfies -20 dBc Criteria and
General Emission 15.209 Criteria Above 2.4835 GHz

7.0 Radiated Spurious Emissions, Receive Mode

7.1 Test Procedure

The EUT was placed on a non-conductive table 0.8 meters above the ground plane. The table was centered on a rotating turntable. The measurement antenna is scanned from 1 to 4 meters in height.

Spurious emissions below 1 GHz were measured with peak and quasi-peak detection with a resolution bandwidth of 120 kHz at a distance of 10 meters. Above 1 GHz the measurement distance was 3 meters with resolution bandwidth of 1 MHz and using peak and average detection. A diagram showing the test setup is given in the figure below.

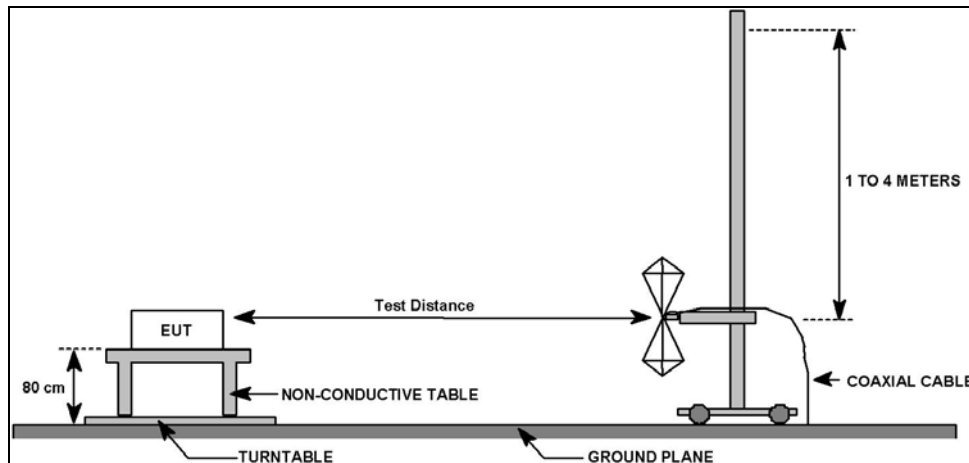


Figure 7.1.1: Field Strength of Spurious Emissions Test Setup

7.2 Test Criteria

47 CFR (USA) // IC (Canada)		
Section Reference	Parameter	Date(s)
15.247, 15.209 // RSS-247 5.5, RSS-Gen 7.1	Field Strength of Radiated Spurious/Harmonic Emissions	20 Jan 2016

7.3 Test Results

The EUT satisfied the criteria. Recorded data is presented below.

Table 7.3.1: Radiated Spurious Emissions, Receive Mode, Below 1 GHz, Vertical Polarity

Professional Testing, EMI, Inc.									
Test Method:		ANSI C63.4–2003: “Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz” (incorporated by reference, see §15.38).							
In accordance with:		FCC Part 15.209 - Code of Federal Regulations Part 47, Subpart C - Intentional Radiators, Radiated Emissions Limits							
Section:		15.209							
Test Date(s):		1/20/2016		EUT Serial #:		0			
Customer:		Virtuix		EUT Part #:		0			
Project Number:		17650-15		Test Technician:		Eric Lifsey			
Purchase Order #:		NA		Supervisor:		Lisa Arndt			
Equip. Under Test:		PODS		Witness' Name:		Brian Olinger			
Radiated Emissions Test Results Data Sheet								Page: 1 of 1	
EUT Line Voltage:		230 VAC		EUT Power Frequency:		50 Hz			
Antenna Orientation:		Vertical		Frequency Range:		30MHz to 1GHz			
EUT Mode of Operation:				Receive Mode					
Frequency Measured (MHz)	Test Distance (Meters)	EUT Direction (Degrees)	Antenna Height (Meters)	Detector Function	Recorded Amplitude (dBμV)	Corrected Level (dBμV/m)	Limit Level (dBμV/m)	Margin (dB)	Test Results
38.286	10	272	2.13	Quasi-peak	41.4	25.533	29.5	-4.0	Pass
42.521	10	185	1.21	Quasi-peak	44.6	27.299	29.5	-2.2	Pass
43.5621	10	353	1.46	Quasi-peak	45.1	28.12	29.5	-1.4	Pass
44.6313	10	278	1.22	Quasi-peak	45.7	29.046	29.5	-0.5	Pass
45.7031	10	263	1.51	Quasi-peak	45.4	28.093	29.5	-1.4	Pass
54.2631	10	85	1.22	Quasi-peak	43.9	25.573	29.5	-3.9	Pass
56.1785	10	68	2.17	Quasi-peak	43.6	25.808	29.5	-3.7	Pass

Professional Testing, EMI, Inc

Radiated Emissions, 10m Distance

30MHz - 1GHz Vertical Polarity Measured Emissions

Quasi-peak Limit Level

Corrected Quasi-peak Reading

Peak Limit Level


Corrected Peak Value

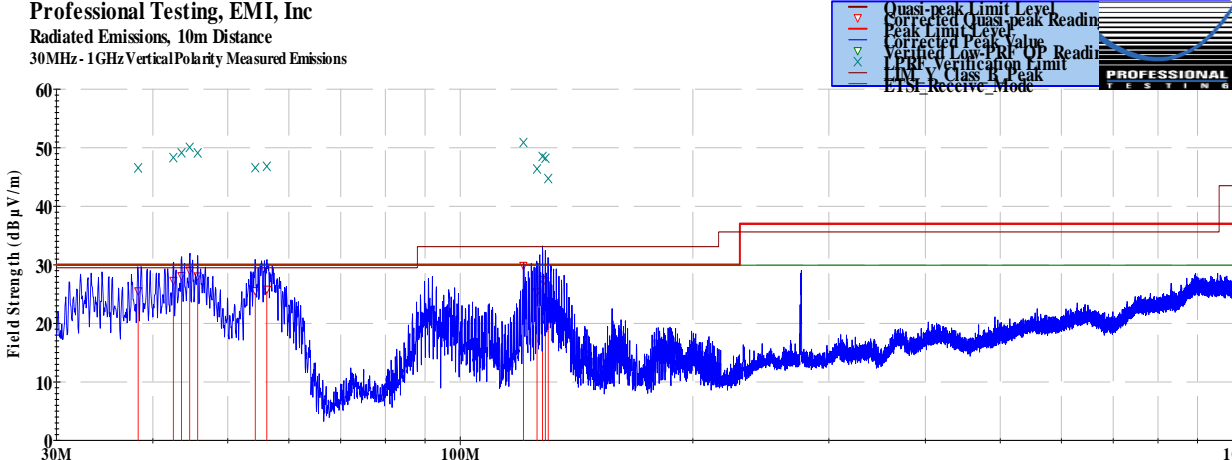
Verified Low-PRI OP Reading

EMC Verification Limit

EMC Class B Quasi-peak

EMC Receive Mode





Operator: Eric Lifsey

17650\012016\Run04\RE\RxSpurious\GAZRadio.tif

03:45:46 PM, Friday, January 22, 2016

Mode: Receive

Power: 230/50

Aggregator Gazelle & POD

EUT: OmniSystem Aggregator & POD

Project Number: 17650-15

Client: Virtuix

≤ 1GHz Vertical Antenna Polarity Measured Emissions

Table 7.3.2: Radiated Spurious Emissions, Receive Mode, Below 1 GHz, Horizontal Polarity

Professional Testing, EMI, Inc.									
Test Method:		ANSI C63.4–2003: “Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz” (incorporated by reference, see §15.38).							
In accordance with:		FCC Part 15.209 - Code of Federal Regulations Part 47, Subpart C - Intentional Radiators, Radiated Emissions Limits							
Section:		15.209							
Test Date(s):		1/20/2016		EUT Serial #:		0			
Customer:		Virtuix		EUT Part #:		0			
Project Number:		17650-15		Test Technician:		Eric Lifsey			
Purchase Order #:		NA		Supervisor:		Lisa Arndt			
Equip. Under Test:		PODS		Witness' Name:		Brian Olinger			
Radiated Emissions Test Results Data Sheet								Page: 1 of 1	
EUT Line Voltage:		230 VAC		EUT Power Frequency:		50 Hz			
Antenna Orientation:		Horizontal		Frequency Range:		30MHz to 1GHz			
EUT Mode of Operation:				Receive Mode					
Frequency Measured (MHz)	Test Distance (Meters)	EUT Direction (Degrees)	Antenna Height (Meters)	Detector Function	Recorded Amplitude (dBµV)	Corrected Level (dBµV/m)	Limit Level (dBµV/m)	Margin (dB)	Test Results
89.8975	10	96	3.66	Quasi-peak	46	26.37	33.1	-6.7	Pass
90.9217	10	290	3.21	Quasi-peak	46.8	27.314	33.1	-5.8	Pass
128.851	10	99	3.68	Quasi-peak	41.7	24.387	33.1	-8.7	Pass
129.908	10	119	2.73	Quasi-peak	41.1	23.777	33.1	-9.3	Pass
275.962	10	78	3.64	Quasi-peak	22.4	11.928	35.6	-23.7	Pass
957.516	10	273	2.1	Quasi-peak	21.1	26.337	35.6	-9.3	Pass

Professional Testing, EMI, Inc

Radiated Emissions, 10m Distance

30MHz - 1GHz Horizontal Polarity Measured Emissions

Quasi-peak Limit Level

Corrected Quasi-peak Reading

Peak Limit Level

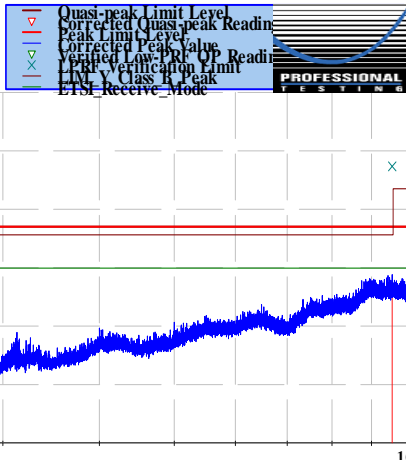
Corrected Peak Value

Verified Low-Pk OP Reading

Verification Limit

Class B Peak

ETSI Receive Mode



Operator: Eric Lifsey

17650\012016\Run04\RE\RxSpurious\GAZRadio.tif

03:45:46 PM, Friday, January 22, 2016

Mode: Receive

Power: 230/50

Aggregator Gazelle & POD

EUT: OmniSystem Aggregator & POD

Project Number: 17650-15

Client: Virtuix

≤ 1GHz Horizontal Antenna Polarity Measured Emissions

≤ 1GHz Horizontal Antenna Polarity Measured Emissions

Table 7.3.3: Radiated Spurious Emissions, Receive Mode, Above 1 GHz, Middle Channel, Vertical Polarity

Professional Testing, EMI, Inc.										
Test Method:		ANSI C63.4–2003: “Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz” (incorporated by reference, see §15.38).								
In accordance with:		FCC Part 15.209 - Code of Federal Regulations Part 47, Subpart C - Intentional Radiators, Radiated Emissions Limits								
Section:		15.209								
Test Date(s):		1/20/2016			EUT Serial #:		0			
Customer:		Virtuix			EUT Part #:		0			
Project Number:		17650-15			Test Technician:		Eric Lifsey			
Purchase Order #:		NA			Supervisor:		Lisa Arndt			
Equip. Under Test:		PODS			Witness' Name:		Brian Olinger			
Radiated Emissions Test Results Data Sheet										
EUT Line Voltage:		230		VAC		EUT Power Frequency:		50		Hz
Antenna Orientation:		Vertical				Frequency Range:		Above 1GHz		
EUT Mode of Operation:					Receive Mode					
Frequency Measured (MHz)	Test Distance (Meters)	EUT Direction (Degrees)	Antenna Height (Meters)	Detector Function	Recorded Amplitude (dBμV)	Corrected Level (dBμV/m)	Limit Level (dBμV/m)	Margin (dB)	Test Results	
2442.5	3	202	0.6	Peak	44.4	35.843	74.0	-38.1	Pass	
4316.35	3	277	0.6	Peak	42.6	38.011	74.0	-35.9	Pass	
4874.21	3	244	0.6	Average	33.2	29.43	54.0	-24.5	Pass	
9758.61	3	62	0.6	Average	26.5	33.41	54.0	-20.5	Pass	

Professional Testing, EMI, Inc
Radiated Emissions, 3m Distance
1-18GHz Vertical Polarity Measured Emissions

▽

Average Limit Level

▽

Corrected Average Reading

—

Peak Limit Level

—

Corrected Peak Reading

—

LIM Y Class B Peak

—

LIM Y Class B OP AVG

—

ETSI Receive Mode

Operator: Eric Lifsey
17650\012016\Run04\RE\RxSpurious\GAZRadio.tif
03:53:24 PM, Friday, January 22, 2016

Mode: Receive
Power: 230/50
Aggregator Gazelle & POD

EUT: OmniSystem Aggregator & POD
Project Number: 17650-15
Client: Virtuix

1 to 18 GHz Vertical Antenna Polarity Measured Emissions

1 to 18 GHz Vertical Antenna Polarity Measured Emissions

Table 7.3.4: Radiated Spurious Emissions, Receive Mode, Above 1 GHz, Middle Channel, Horizontal Polarity

Professional Testing, EMI, Inc.									
Test Method:		ANSI C63.4–2003: “Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz” (incorporated by reference, see §15.38).							
In accordance with:		FCC Part 15.209 - Code of Federal Regulations Part 47, Subpart C - Intentional Radiators, Radiated Emissions Limits							
Section:		15.209							
Test Date(s):		1/20/2016			EUT Serial #:		0		
Customer:		Virtuix			EUT Part #:		0		
Project Number:		17650-15			Test Technician:		Eric Lifsey		
Purchase Order #:		NA			Supervisor:		Lisa Arndt		
Equip. Under Test:		PODS			Witness' Name:		Brian Olinger		
Radiated Emissions Test Results Data Sheet								Page: 1 of 1	
EUT Line Voltage:		230 VAC		EUT Power Frequency:		50 Hz			
Antenna Orientation:		Horizontal			Frequency Range:		Above 1GHz		
EUT Mode of Operation:					Receive Mode				
Frequency Measured (MHz)	Test Distance (Meters)	EUT Direction (Degrees)	Antenna Height (Meters)	Detector Function	Recorded Amplitude (dBμV)	Corrected Level (dBμV/m)	Limit Level (dBμV/m)	Margin (dB)	Test Results
2435.17	3	298	0.6	Peak	44	35.456	74.0	-38.5	Pass
4871.15	3	62	0.6	Peak	41.7	37.935	74.0	-36.0	Pass
7311.94	3	300	0.6	Average	28.9	32.28	54.0	-21.7	Pass
9757.21	3	72	0.6	Average	26.5	33.367	54.0	-20.6	Pass

Professional Testing, EMI, Inc

Radiated Emissions, 3m Distance

1-18GHz Horizontal Polarity Measured Emissions

Average Limit Level

Corrected Average Reading


Peak Limit Level

Corrected Peak Reading

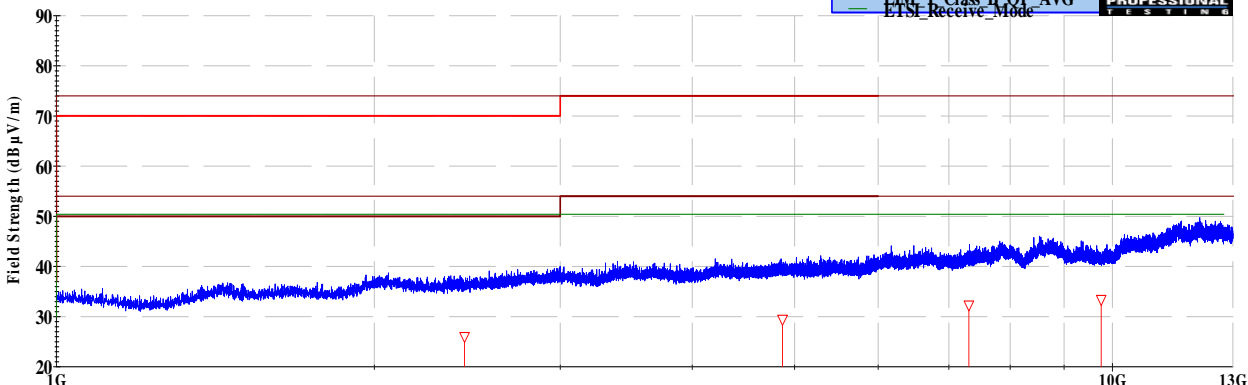
LIM Y Class B Peak

LIM Y Class B OP AVG

EUT Receive Mode



Field Strength (dBμV/m)



Frequency

Operator: Eric Lifsey

17650\012016\Run04\RE\RxSpurious\GAZRadio.tif

03:53:24 PM, Friday, January 22, 2016

Mode: Receive

Power: 230/50

Aggregator Gazelle & POD

EUT: OmniSystem Aggregator & POD

Project Number: 17650-15

Client: Virtuix

1 to 18 GHz Horizontal Antenna Polarity Measured Emissions

1 to 18 GHz Horizontal Antenna Polarity Measured Emissions

8.0 Radiated Spurious Emissions, Transmit Mode

8.1 Test Procedure

The EUT was placed on a non-conductive table 0.8 meters above the ground plane. The EUT was centered on a rotating turntable.

Spurious emissions below 1 GHz were measured with peak and quasi-peak detection with a resolution bandwidth of 120 kHz at a distance of 10 meters. Above 1 GHz the measurement distance was 3 meters with resolution bandwidth of 1 MHz and using peak and average detection. A diagram showing the test setup is given in the figure below.

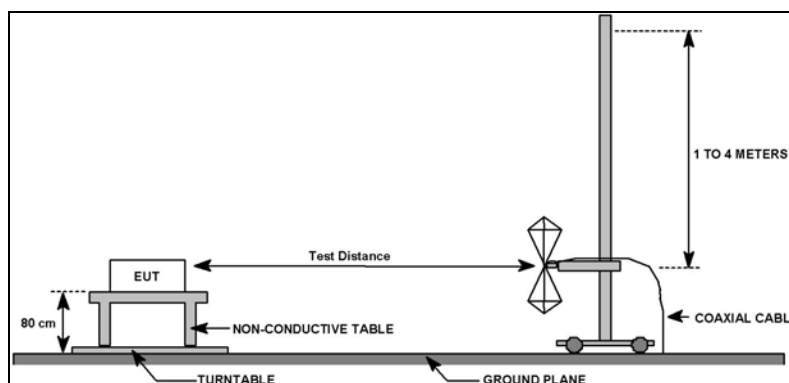


Figure 8.1.1: Field Strength of Spurious Emissions Test Setup

8.2 Test Criteria

47 CFR (USA) // IC (Canada)		
Section Reference	Parameter	Date(s)
15.247, 15.209 // RSS-247 5.5, RSS-Gen 6.13	Field Strength of Radiated Spurious/Harmonic Emissions	20 Jan 2016

8.3 Test Results

In all cases detector mode is peak, RBW 1 MHz, VBW 3 MHz. All peak emissions can be seen as being below the average or QP limits.

The EUT satisfied the criteria. Recorded data is presented below.

Table 8.3.1: Radiated Spurious Emissions, Transmit Mode, Below 1 GHz, Three Channels, Vertical Polarity

Professional Testing, EMI, Inc.										
Test Method:		ANSI C63.4–2003: “Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz” (incorporated by reference, see §15.38).								
In accordance with:		FCC Part 15.209 - Code of Federal Regulations Part 47, Subpart C - Intentional Radiators, Radiated Emissions Limits								
Section:		15.209								
Test Date(s):		1/20/2016			EUT Serial #:		0			
Customer:		Virtuix			EUT Part #:		0			
Project Number:		17650-15			Test Technician:		Eric Lifsey			
Purchase Order #:		NA			Supervisor:		Lisa Arndt			
Equip. Under Test:		PODS			Witness' Name:		Brian Olinger			
Radiated Emissions Test Results Data Sheet										
										Page: 1 of 1
EUT Line Voltage:		230 VAC		EUT Power Frequency:		50 Hz				
Antenna Orientation:		Vertical			Frequency Range:		30MHz to 1GHz			
EUT Mode of Operation:					Transmit Mode, Modulated, 3 Channels/EUTs					
Frequency Measured (MHz)	Test Distance (Meters)	EUT Direction (Degrees)	Antenna Height (Meters)	Detector Function	Recorded Amplitude (dBμV)	Corrected Level (dBμV/m)	Limit Level (dBμV/m)	Margin (dB)	Test Results	
37.5511	10	18	1.4	Quasi-peak	40.8	25.917	29.5	-3.6	Pass	
41.4601	10	107	1.36	Quasi-peak	44.1	26.42	29.5	-3.1	Pass	
43.5688	10	109	1.48	Quasi-peak	44.8	27.862	29.5	-1.6	Pass	
56.1636	10	181	3.14	Quasi-peak	43.6	25.787	29.5	-3.7	Pass	
<div>Professional Testing, EMI, Inc Radiated Emissions, 10m Distance 30MHz - 1GHz Vertical Polarity Measured Emissions</div> <div><div><div>Quasi-peak Limit Level</div><div>Corrected Quasi-peak Reading</div><div>Peak Limit Level</div><div>Corrected Peak Value</div><div>Verified Low-Freq OP Reading</div><div>Limit Violation Limit</div><div>Limit V. Class B Peak</div><div>EUT Transmit Spurious</div></div><div>PROFESSIONAL TESTING</div></div> <div>Operator: Eric Lifsey 17650\012016Run07RETxSpurious3ChGAZRadio.tif 02:14:16 PM, Wednesday, January 20, 2016</div> <div>Mode: Transmit, 3 Channels Power: 230/50 Modulated</div> <div>EUT: OmniSystem Project Number: 17650-15 Client: Virtuix</div>										
≤ 1GHz Vertical Antenna Polarity Measured Emissions										

Table 8.3.2: Radiated Spurious Emissions, Transmit Mode, Below 1 GHz, Three Channels, Horizontal Polarity

Professional Testing, EMI, Inc.										
Test Method:		ANSI C63.4–2003: “Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz” (incorporated by reference, see §15.38).								
In accordance with:		FCC Part 15.209 - Code of Federal Regulations Part 47, Subpart C - Intentional Radiators, Radiated Emissions Limits								
Section:		15.209								
Test Date(s):		1/20/2016			EUT Serial #:		0			
Customer:		Virtuix			EUT Part #:		0			
Project Number:		17650-15			Test Technician:		Eric Lifsey			
Purchase Order #:		NA			Supervisor:		Lisa Arndt			
Equip. Under Test:		PODS			Witness' Name:		Brian Olinger			
Radiated Emissions Test Results Data Sheet								Page: 1 of 1		
EUT Line Voltage:		230 VAC		EUT Power Frequency:		50 Hz				
Antenna Orientation:		Horizontal			Frequency Range:		30MHz to 1GHz			
EUT Mode of Operation:					Transmit Mode, Modulated, 3 Channels/EUTs					
Frequency Measured (MHz)	Test Distance (Meters)	EUT Direction (Degrees)	Antenna Height (Meters)	Detector Function	Recorded Amplitude (dBμV)	Corrected Level (dBμV/m)	Limit Level (dBμV/m)	Margin (dB)	Test Results	
88.8138	10	106	3.91	Quasi-peak	45	25.267	33.1	-7.8	Pass	
96.2834	10	113	3.68	Quasi-peak	45.5	27.294	33.1	-5.8	Pass	
121.44	10	276	1.31	Quasi-peak	28.6	11.283	33.1	-21.8	Pass	

Professional Testing, EMI, Inc

Radiated Emissions, 10m Distance

30MHz - 1GHzHorizontalPolarity Measured Emissions

Quasi-peak Limit Level

Corrected Quasi-peak Reading

Peak Limit Level

Corrected Peak Value

Verified Low-PF OP Reading

LPF Verification Limit

Limit X, Class B Peak

EUT Transmit Spurious

Operator: Eric Lifsey

17650\012016\Run07\RETxSpurious3Ch\GAZRadio.ttl

02:14:16 PM, Wednesday, January 20, 2016

Mode: Transmit, 3 Channels

Power: 230/50

Modulated

EUT: OmniSystem

Project Number: 17650-15

Client: Virtuix

≤ 1GHz Horizontal Antenna Polarity Measured Emissions

Table 8.3.3: Radiated Spurious Emissions, Transmit Mode, 1 to 18 GHz, Three Channels, Vertical Polarity

Professional Testing, EMI, Inc.									
Test Method:		ANSI C63.4–2003: “Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz” (incorporated by reference, see §15.38).							
In accordance with:		FCC Part 15.209 - Code of Federal Regulations Part 47, Subpart C - Intentional Radiators, Radiated Emissions Limits							
Section:		15.209							
Test Date(s):		1/20/2016			EUT Serial #:		0		
Customer:		Virtuix			EUT Part #:		0		
Project Number:		17650-15			Test Technician:		Eric Lifsey		
Purchase Order #:		NA			Supervisor:		Lisa Arndt		
Equip. Under Test:		PODS			Witness' Name:		Brian Olinger		
Radiated Emissions Test Results Data Sheet								Page: 1 of 1	
EUT Line Voltage:		230 VAC		EUT Power Frequency:		50 Hz			
Antenna Orientation:		Vertical			Frequency Range:		Above 1GHz		
EUT Mode of Operation:					Transmit Mode, Modulated, 3 Channels/EUTs				
Frequency Measured (MHz)	Test Distance (Meters)	EUT Direction (Degrees)	Antenna Height (Meters)	Detector Function	Recorded Amplitude (dBμV)	Corrected Level (dBμV/m)	Limit Level (dBμV/m)	Margin (dB)	Test Results
4879.9	3	286	0.6	Peak	41.6	37.816	74.0	-36.1	Pass
9596.64	3	138	0.6	Peak	35	42.164	74.0	-31.8	Pass
4879.9	3	286	0.6	Average	32.8	28.986	54.0	-25.0	Pass
9596.64	3	138	0.6	Average	26.5	33.681	54.0	-20.3	Pass

Professional Testing, EMI, Inc

Radiated Emissions, 3m Distance

1-18GHz Vertical Polarity Measured Emissions

Average Limit Level

Corrected Average Reading


Peak Limit Level

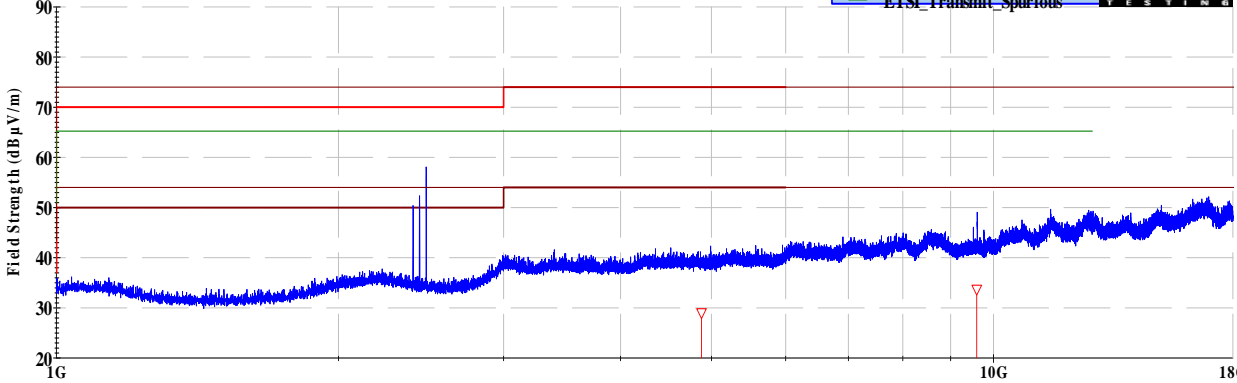
Corrected Peak Reading

LIM Y Class B Peak

LIM Y Class B OP AVG

EUT Transmit Spurious





Operator: Eric Lifsey

17650\012016\Run07\RETxSpurious3Ch\GAZRadio.ttl

03:12:59 PM, Saturday, January 23, 2016

Mode: Transmit, 3 Channels

Power: 230/50

Modulated

EUT: OmniSystem

Project Number: 17650-15

Client: Virtuix

1 to 18 GHz Vertical Antenna Polarity Measured Emissions

Table 8.3.4: Radiated Spurious Emissions, Transmit Mode, 1 to 18 GHz, Three Channels, Horizontal Polarity

Professional Testing, EMI, Inc.										
Test Method:		ANSI C63.4–2003: “Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz” (incorporated by reference, see §15.38).								
In accordance with:		FCC Part 15.209 - Code of Federal Regulations Part 47, Subpart C - Intentional Radiators, Radiated Emissions Limits								
Section:		15.209								
Test Date(s):		1/20/2016			EUT Serial #:		0			
Customer:		Virtuix			EUT Part #:		0			
Project Number:		17650-15			Test Technician:		Eric Lifsey			
Purchase Order #:		NA			Supervisor:		Lisa Arndt			
Equip. Under Test:		PODS			Witness' Name:		Brian Olinger			
Radiated Emissions Test Results Data Sheet								Page: 1 of 1		
EUT Line Voltage:		230 VAC		EUT Power Frequency:		50 Hz				
Antenna Orientation:		Horizontal			Frequency Range:		Above 1GHz			
EUT Mode of Operation:					Transmit Mode, Modulated, 3 Channels/EUTs					
Frequency Measured (MHz)	Test Distance (Meters)	EUT Direction (Degrees)	Antenna Height (Meters)	Detector Function	Recorded Amplitude (dBµV)	Corrected Level (dBµV/m)	Limit Level (dBµV/m)	Margin (dB)	Test Results	
4869.62	3	192	0.6	Peak	41.3	37.517	74.0	-36.4	Pass	
9617.39	3	70	0.6	Peak	34.4	41.477	74.0	-32.5	Pass	
4869.62	3	192	0.6	Average	32.7	28.921	54.0	-25.0	Pass	
9617.39	3	70	0.6	Average	26.5	33.624	54.0	-20.3	Pass	

Professional Testing, EMI, Inc

Radiated Emissions, 3m Distance

1-18GHz Horizontal Polarity Measured Emissions

Average Limit Level

Corrected Average Reading

Peak Limit Level

Corrected Peak Reading

EMC Class B Peak

EMC Class B OP AVG

ETSI Transmit Spurious

Operator: Eric Lifsey

17650\012016\Run07\RE\TxSpurious\3Ch\GAZRadio.ttl

03:12:59 PM, Saturday, January 23, 2016

Mode: Transmit, 3 Channels

Power: 230/50

Modulated

EUT: OmniSystem

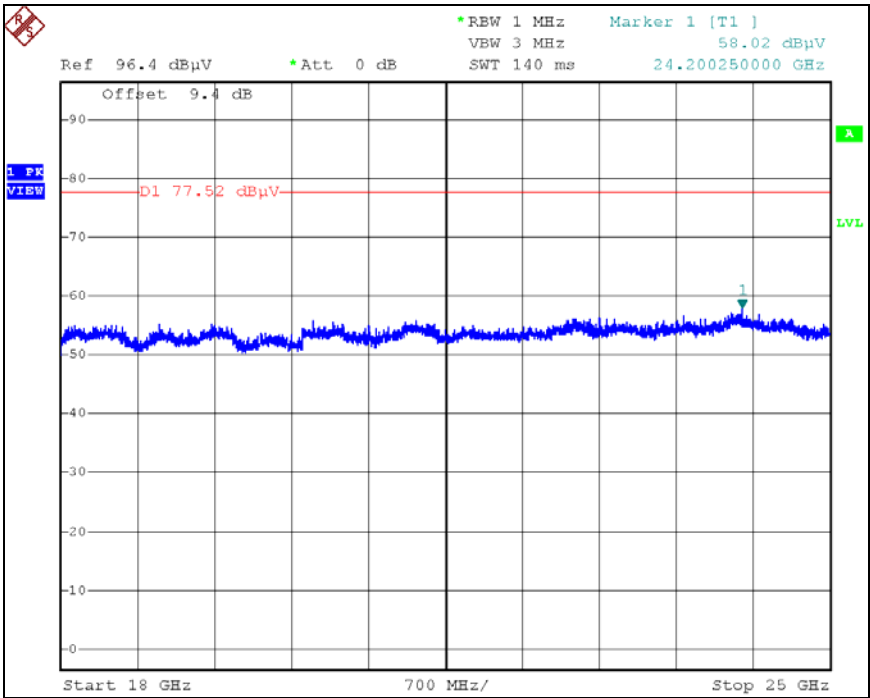
Project Number: 17650-15

Client: Virtuix

1 to 18 GHz Horizontal Antenna Polarity Measured Emissions

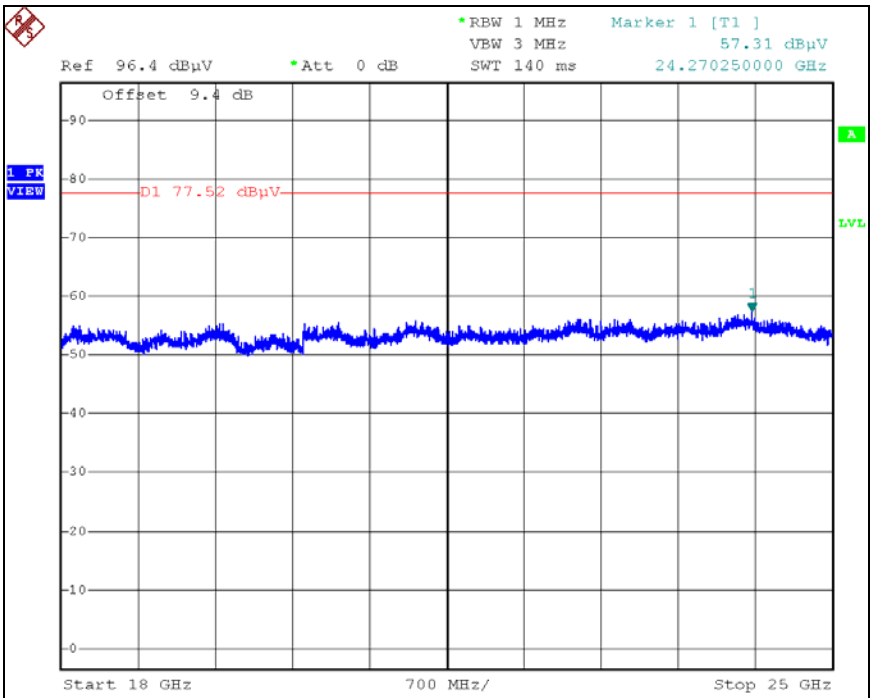
1 to 18 GHz Horizontal Antenna Polarity Measured Emissions

Table 8.3.5: Radiated Spurious Emissions, Transmit Mode, 18 to 26 GHz, Bottom Channel, Vertical & Horizontal Polarity



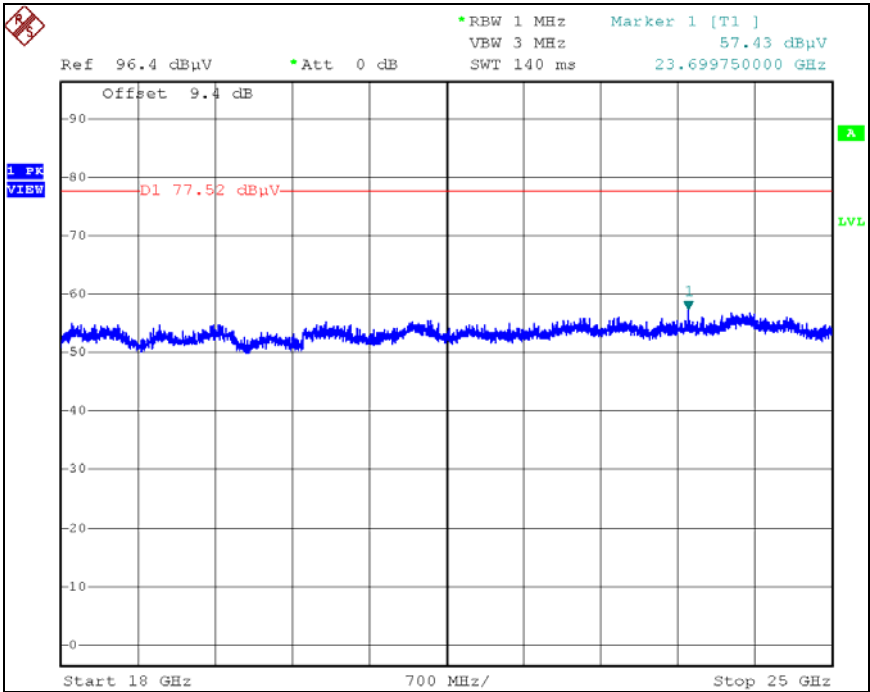
Low Channel, Max Hold of Both Polarities
Corrected for Gain/Loss, Limit as Shown for Distance 20 cm

Table 8.3.6: Radiated Spurious Emissions, Transmit Mode, 18 to 26 GHz, Middle Channel, Vertical & Horizontal Polarity



Middle Channel, Max Hold of Both Polarities
Corrected for Gain/Loss, Limit as Shown for Distance 20 cm

Table 8.3.7: Radiated Spurious Emissions, Transmit Mode, 18 to 26 GHz, Top Channel, Vertical & Horizontal Polarity



**High Channel, Max Hold of Both Polarities
Corrected for Gain/Loss, Limit as Shown for Distance 20 cm**

9.0 Antenna Construction Requirements

The design was investigated for meeting the antenna construction requirements of the applicable rules.

9.1 Procedure

A direct examination of the antenna construction is performed and compared to rule criteria that prevent wireless device antennas from being modified by end users in ways that would void their authorization to use the device.

9.2 Criteria

47 CFR (USA) // IC (Canada)		
Section Reference	Parameter	Date(s)
15.203 // RSS-Gen 8.3	Antenna Construction	25 Feb 2016

9.3 Results

Table 9.3.1 Antenna Construction Details	
Antenna Manufacturer and Model	Specifications
Manufacturer: MAG. LAYERS SCIENTIFIC-TECHNICS CO., LTD Model: P/N LTA-5320-2G4S3-A1-RU	Chip antenna. Peak gain: 0~1 dBi* *The effect of gain is captured in the radiated measurements.

- The antenna is internal only to the device.
- The antenna is soldered component on the circuit board.
- There is no antenna connector.

The antenna design above satisfies the requirements of the rules.

10.0 Equipment and Bandwidths

10.1 Equipment for Radiated Power, Band Edge and Spurious Emissions 30 MHz to 18 GHz

Professional Testing, EMI, Inc.					
Test Method:		ANSI C63.4-2003: "Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz" (incorporated by reference, see §15.38).			
In accordance with:		FCC Part 15.209 - Code of Federal Regulations Part 47, Subpart C - Intentional Radiators, Radiated Emissions Limits			
Section:		15.209			
Test Date(s):	1/18/2016	EUT Serial #:	0		
Customer:	Virtuix	EUT Part #:	0		
Project Number:	17649-15	Test Technician:	Eric Lifsey		
Purchase Order #:	NA	Supervisor:	Lisa Arndt		
Equip. Under Test:	PODS	Witness' Name:	Brian Olinger, Patrick Herron		
Radiated Emissions Test Equipment List					
Tile! Software Version:		4.2.A, May 23, 2010, 08:38:52 AM			
Test Profile:		2015 Rad Emissions_ClassA - LowPRF_072715.til or 2015 Rad Emissions_ClassB - LowPRF_072715.til			
Asset #	Manufacturer	Model	Equipment Nomenclature	Serial Number	Calibration Due Date
1509A	Braden	N/A	TDK 10M Chamber, NSA < 1 GHz	DAC-012915-005	2/5/2016
1890	HP	8447F	Preamp/Amp, 9kHz-1300MHz, 28/25dB	3313A05298	2/6/2016
1937	Agilent	E4440A	Spectrum Analyzer, 3 Hz - 26.5 GHz, Opt. AYZ	MY44808298	12/15/2016
1926	ETS-Lindgren	3142D	Antenna, Biconilog, 26 MHz - 6 GHz	135454	1/25/2017
C027D	none	RG214	Cable Coax, N-N, 25m	none	10/1/2016
1327	EMCO	1050	Controller, Antenna Mast	none	N/A
0942	EMCO	11968D	Turntable, 4ft.	9510-1835	N/A
1969	HP	11713A	Attenuator/Switch Driver	3748A04113	N/A
1509B	Braden	N/A	TDK 10M Chamber, VSWR > 1 GHz	DAC-012915-005	3/13/2016
2004	Miteq	AFS44-00101800-2S-10P-44	Amplifier, 40dB, .1-18GHz	0	1/11/2018
C030	none	none	Cable Coax, N-N, 30m	none	10/1/2016
1325	EMCO	1050	Controller, Antenna Mast	9003-1461	N/A
1780	ETS-Lindgren	3117	Antenna, Double Ridged Guide Horn, 1 - 18 GHz	110313	2/25/2017

10.2 Equipment for Bandwidth and Duty Cycle Timings

Asset #	Manufacturer	Model #	Description	Calibration Due
ALN-077	Rohde & Schwarz	FSP-30	Spectrum Analyzer	16 Dec 2016

10.3 Equipment for 18 to 25 GHz Emission Measurement

Asset #	Manufacturer	Model #	Description	Calibration Due
ALN-077	Rohde & Schwarz	FSP-30	Spectrum Analyzer	16 Dec 2016
1974	Agilent	83017A	Microwave Amplifier	17 Dec 2017
1542	AH Systems	SAS-572	Horn Antenna, Standard Gain, 20 dB	CNR

10.4 Measurement Bandwidths, Radiated

Radiated Emissions Spectrum Analyzer Bandwidth and Measurement Time - Peak Scan				
Frequency Band Start (MHz)	Frequency Band Stop (MHz)	6 dB Bandwidth (kHz)	Number of Ranges Used	Measurement Time per Range
0.009	0.15	0.3	2	Multiple Sweeps
0.15	30	9	6	Multiple Sweeps
30	1000	120	2	Multiple 800 mS Sweeps
1000	6000	1000	2	Multiple Sweeps
6000	18000	1000	2	Multiple Sweeps
18000	26500	1000	2	Multiple Sweeps

***Notes:**

1. The settings above are specifically calculated for the E4440A series of spectrum analyzers, which have 8,000 data points per range.
2. The measurement receiver resolution bandwidth setting was 300 Hz for quasi-peak measurements from 9-150 kHz.
3. The measurement receiver resolution bandwidth setting was 9 kHz for quasi-peak measurements from 0.15-30 MHz.
4. The measurement receiver resolution bandwidth setting was 120 kHz for quasi-peak measurements from 30-1000 MHz.
5. The measurement receiver resolution bandwidth setting was 1 MHz for average measurements from 1-18 GHz.

Appendix: Policy, Rationale, and Evaluation of EMC Measurement Uncertainty

All uncertainty calculations, estimates and expressions thereof shall be in accordance with NIST policy. Since PTI operates in accordance with NIST (NVLAP) Handbook 150-11: 2007, all instrumentation having an effect on the accuracy or validity of tests shall be periodically calibrated or verified traceable to national standards by a competent calibration laboratory. The certificates of calibration or verification on this instrumentation shall include estimates of uncertainty as required by NIST Handbook 150-11.

1. Rationale and Summary of Expanded Uncertainty.

Each piece of instrumentation at PTI that is used in making measurements for determining conformance to a standard (or limit), shall be assessed to evaluate its contribution to the overall uncertainty of the measurement in which it is used. The assessment of each item will be based on either a type A evaluation or a type B evaluation. Most of the evaluations will be type B, since they will be based on the manufacturer's statements or specifications of the calibration tolerances, or uncertainty will be stated along with a brief rationale for the type of evaluation and the resulting stated uncertainties.

The individual uncertainties included in the combined standard uncertainty for a specific test result will depend on the configuration in which the item of instrumentation is used. The combination will always be based on the law of propagation of uncertainty. Any systematic effects will be accommodated by including their uncertainties, in the calculation of the combined standard uncertainty; except that if the direction and amount of the systematic effect cannot be determined and separated from its uncertainty, the whole effect will be treated as uncertainty and combined along with the other elements of the test setup.

Type A evaluations of standard uncertainty will usually be based on calculating the standard deviation of the mean of a series of independent observations, but may be based on a least-squares curve fit or the analysis of variance for unusual situations. Type B evaluations of standard uncertainty will usually be based on manufacturer's specifications, data provided in calibration reports, and experience. The type of probability distribution used (normal, rectangular, a priori, or u-shaped) will be stated for each Type B evaluation.

In the evaluation of the uncertainty of each type of measurement, the uncertainty caused by the operator will be estimated. One notable operator contribution to measurement uncertainty is the manipulation of cables to maximize the measured values of radiated emissions. The operator contribution to measurement uncertainty is evaluated by having several operators independently repeat the same test. This results in a Type A evaluation of operator-contributed measurement uncertainty.

A summary of the expanded uncertainties of PTI measurements is shown as Table 1. These are the worst-case uncertainties considering all operative influence factors.

Table 1: Summary of Measurement Uncertainties for Site 45

Type of Measurement	Frequency Range	Meas. Dist.	Expanded Uncertainty U, dB (k=2)
Mains Conducted Emissions	150 kHz to 30 MHz	N/A	2.9
Telecom Conducted Emissions	150 kHz to 30 MHz	N/A	2.8
Radiated Emissions	30 to 1,000 MHz	10 m	4.8
	1 to 18 GHz	3 m	5.7

End of Report

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