
Project 17649-15

POD
2.4 GHz Movement Sensor

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

9 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.	24 Feb 2016
01	Revised.	9 Mar 2016

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Corrections:

None.



Certificate of Compliance

Applicant	Device & Test Identification
Virtuix, Inc. (Doug Shuffield) 1826 Kramer Lane, Suite H Austin, TX 78758 Certificate Date: 9 Mar 2016	FCC ID: 2AHFN-PODV001 Industry Canada ID: 21168-PODV001 Model(s): POD Laboratory Project ID: 17649-15

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. It snaps onto custom shoes worn by the user to detect individual foot movement and position. It reports this data by wireless means to a companion aggregator board that occupies the base upon which the user stands and moves.

Table 1.2.1: Equipment Under Test		
Manufacturer / Model	Serial #	Description
Virtuix, Inc. POD	None	Wireless position sensor 2400-2483.5 transceiver

The device employs a chip antenna. The EUT is powered by an internal rechargeable 3.7 V battery.

The EUT measures approximately 35 x 35 x 15 mm.

1.3 EUT Operation

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

1.4 Modifications to Equipment

No modifications were made to the EUT during the performance of the test program.

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:

Raw Measured Level + Antenna Factor + Cable Losses – Amplifier Gain = Corrected Level
--

Conducted RF levels are determined as follows:

Raw Measured Level + Attenuator Factor + Cable Losses = Corrected Level

Conducted mains levels are determined as follows:

Raw Measured Level + LISN Factor + Cable/Filter/Limiter Losses = 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 dBμV/m	18 Jan 2016

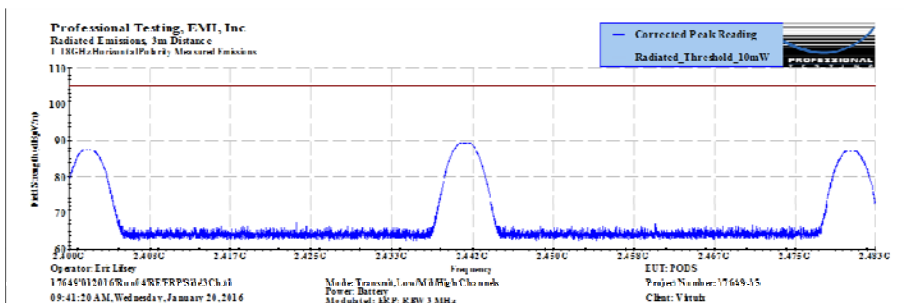
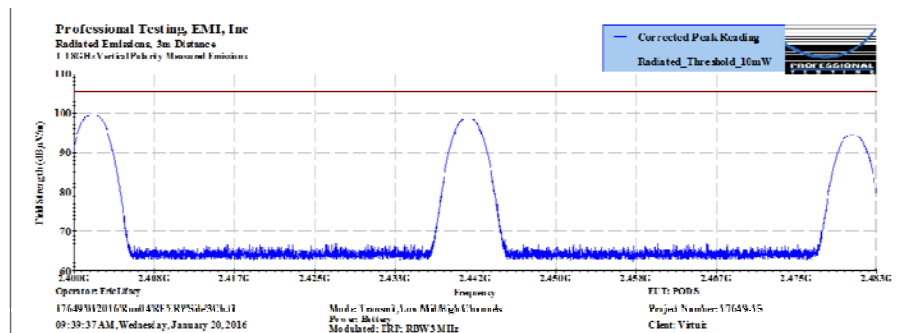
2.3 Test Results

The EUT bandwidth was found to be between 1 MHz and 3 MHz, the measurement resolution bandwidth was set accordingly. Maximum polarity was vertical with EUT oriented in side position.

Table 2.3.1 Radiated Power at 3 meters, Maximum Polarity & Orientation	
Frequency MHz	Measured Radiated Peak Power dBμV/m @ 3m
2402	99.6
2441	98.6
2481	94.5

Measured in 3 MHz RBW, 3 MHz VBW.

The EUT satisfied the requirement. Note that the highest frequency channel has power reduced to satisfy band-edge emissions. Plotted measurements appears below.



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	18 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	24 Feb 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

This measurement was not required due to the low fundamental power and spurious levels.

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	19 Jan 2016

5.3 Test Results

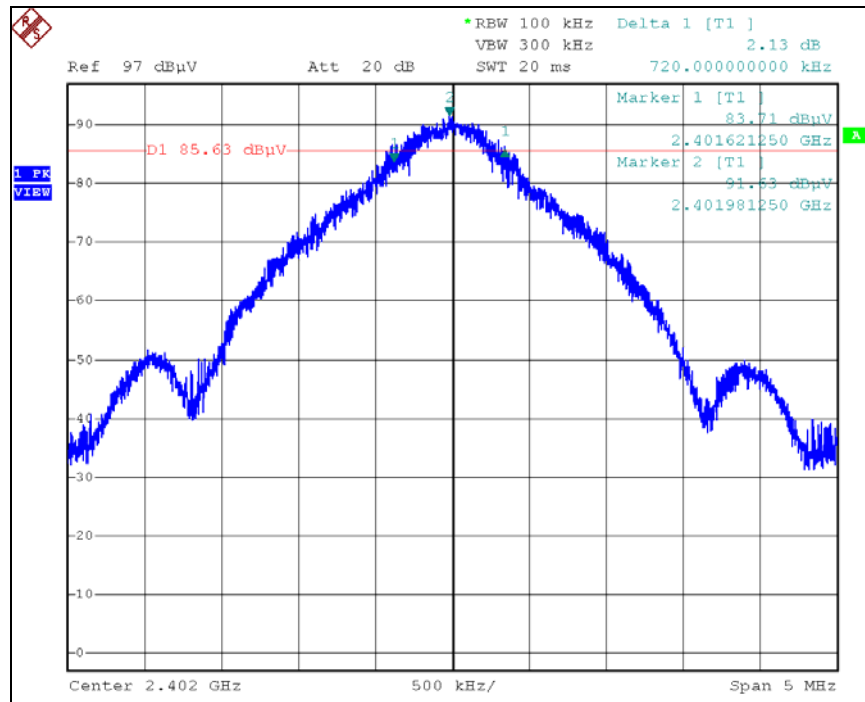
EUT was found to be in compliance with applicable requirements.

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)
720	720	770	720

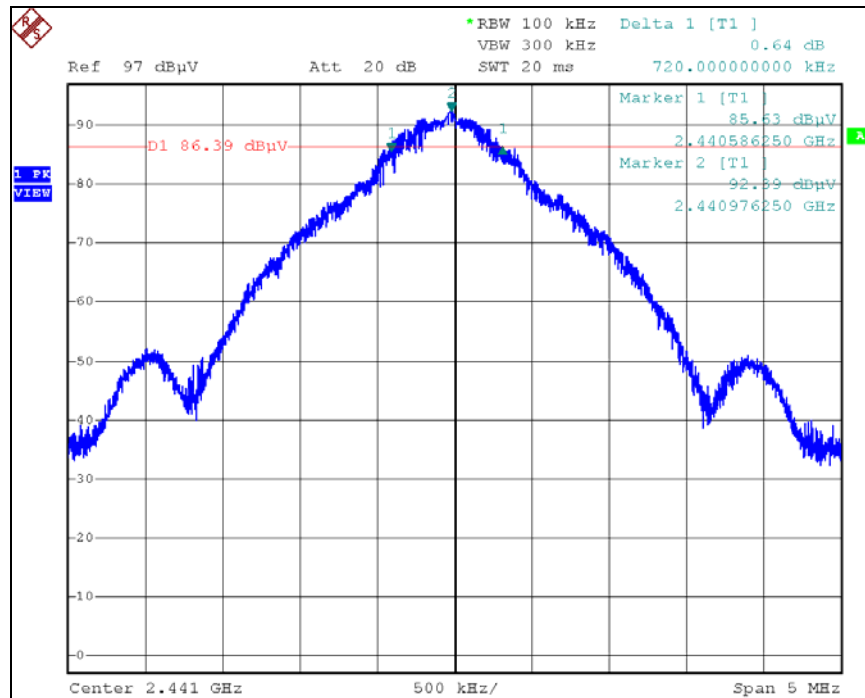
Table 5.3.2 Bandwidth 20 dB, Measure and Report			
Low Channel Measured BW (kHz)	Mid Channel Measured BW (kHz)	High Channel Measured BW (kHz)	Reported Maximum BW (kHz)
1610	1590	1530	1610

Plotted measurements appear on the following pages.

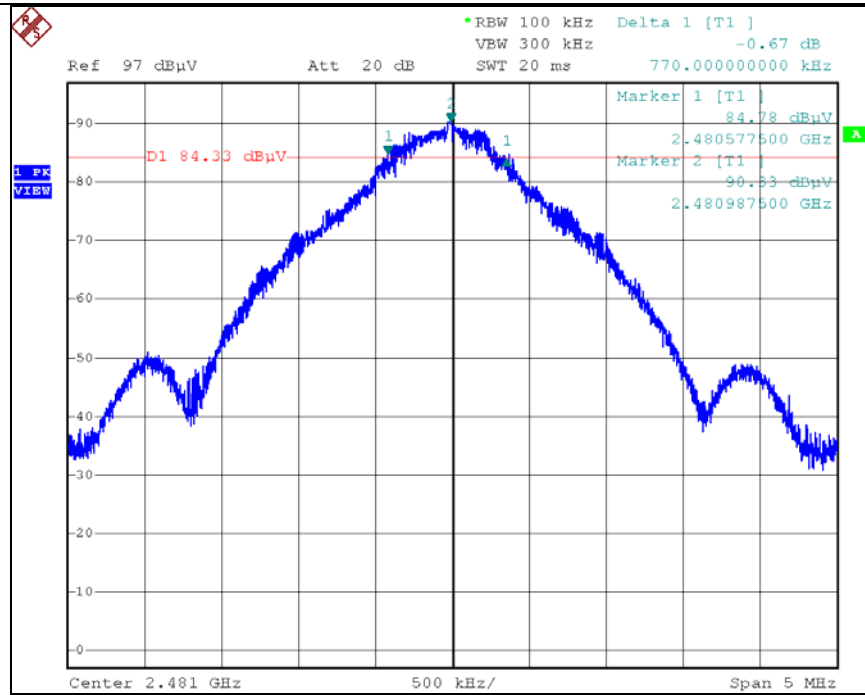
5.3.1 Bandwidth Plots, 6 dB



6 dB, Low Channel

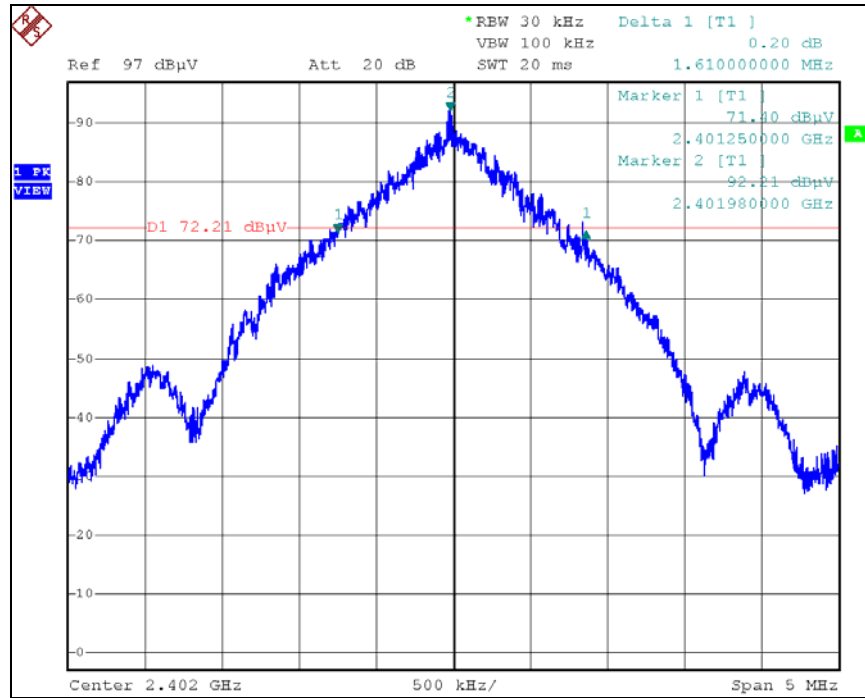


6 dB, Middle Channel

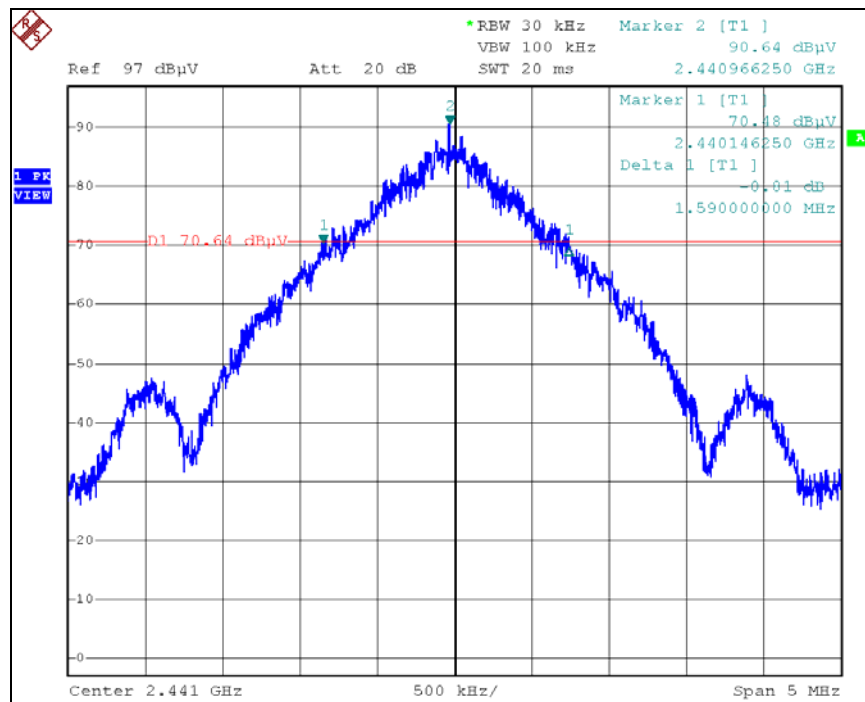


6 dB, High Channel

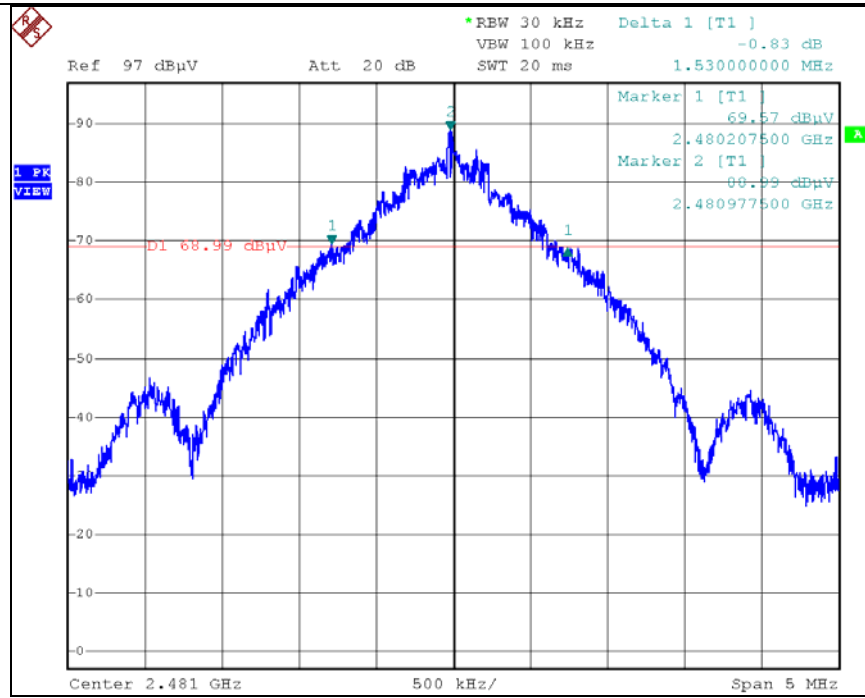
5.3.2 Bandwidth Plots, 20 dB



20 dB, Low Channel



20 dB, Middle Channel



20 dB, High 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	18 Jan 2016

6.3 Test Results

Peak detection emissions at band edges were below the applicable general emission peak limits or the -20 dBc limit (shown in green).

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):		1/18/2016		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 Results Data Sheet								Page: 1 of 1	
EUT Line Voltage:		3.7 VDC		EUT Power Frequency:		0 N/A			
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
2395.12	10	63	1	Peak	45.4	36.747	63.5	-26.8	Pass

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

Operator: Eric Lifsey
17649\012016\Run01\RETxBandEdgeMask\Lower.tif
10:56:37 AM, Wednesday, January 20, 2016

Mode: Transmit, 2 Channels; low/high
Power: Battery
Modulated; band-edge and OOB domain

EUT: PODS
Project Number: 17649-15
Client: Virtuix

Band Edge, Lower
EUT Satisfies -20 dBc Criteria

Peak detection levels shown.

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):		1/18/2016			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 Results Data Sheet								Page: 1 of 1	
EUT Line Voltage:		3.7 VDC		EUT Power Frequency:		0 N/A			
Antenna Orientation:		Horizontal		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
2489.13	10	320	1	Peak	43.3	34.926	65.2	-30.3	Pass

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

Operator: Eric Lifsey
17649\012016\Run02\RETxBandEdgeMaskUpper.tif
11:07:31 AM, Wednesday, January 20, 2016

Mode: Transmit, 2 Channels; low/high
Power: Battery
Modulated; band-edge and OOB domain

EUT: PODS
Project Number: 17649-15
Client: Virtuix

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

Peak detection levels shown.

7.0 Radiated Spurious Emissions, Receive Mode (Charging)

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.

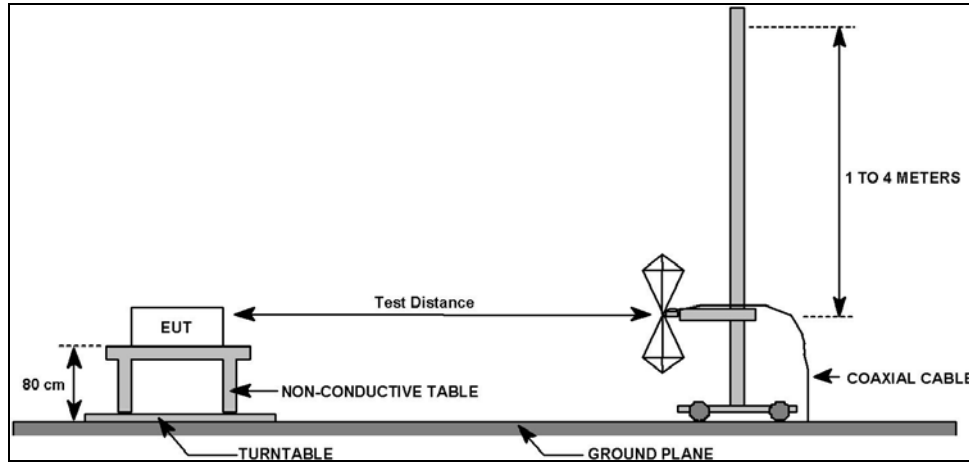


Figure 7.1.1: Field Strength of Spurious Emissions Test Setup

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	18 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 15.109 - Code of Federal Regulations Part 47, Subpart B - Unintentional Radiators, Radiated Emissions Limits							
Section:		15.109							
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 Results Data Sheet								Page: 1 of 1	
EUT Line Voltage:		0 VDC		EUT Power Frequency:		0 N/A			
Antenna Orientation:		Vertical		Frequency Range:		30MHz to 1GHz			
EUT Mode of Operation:				Charging 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
35.709	10	154	1.61	Quasi-peak	31.1	18.659	29.5	-10.8	Pass
60.0077	10	321	3.8	Quasi-peak	33.9	15.665	29.5	-13.8	Pass
101.491	10	14	1.51	Quasi-peak	35.5	19.064	33.1	-14.0	Pass
255.143	10	57	1.56	Quasi-peak	24.8	14.614	35.6	-21.0	Pass
891.318	10	281	1.46	Quasi-peak	21.3	26.197	35.6	-9.4	Pass
945.526	10	136	1.35	Quasi-peak	21	26.202	35.6	-9.4	Pass

Professional Testing, EMI, Inc
Radiated Emissions, 10m Distance
30MHz- 1GHz VerticalPolarity Measured Emissions

Corrected Quasi-peak Reading

Corrected Peak Value

Verified Low-PRF QP Reading

LPRF Verification Limit

LIM_Y_Class B Peak

PROFESSIONAL TESTING

Operator: Eric Lifsey
17649Run06b'REChargeModestandardUSBCableFCC+IC.ttl Mode:Charging
Power: 230/50
11:49:21 AM, Monday, January 18, 2016 Cable: Standard USB1 m

EUT: PODS
Project Number: 17649-15
Client: Virtuix

≤ 1GHz Vertical Antenna Polarity Measured Emissions

≤ 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 15.109 - Code of Federal Regulations Part 47, Subpart B - Unintentional Radiators, Radiated Emissions Limits								
Section:		15.109								
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 Results Data Sheet								Page: 1 of 1		
EUT Line Voltage:		0		VDC		EUT Power Frequency:		0		N/A
Antenna Orientation:		Horizontal				Frequency Range:		30MHz to 1GHz		
EUT Mode of Operation:					Charging 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	
37.0837	10	298	1.37	Quasi-peak	23.7	9.409	29.5	-20.1	Pass	
104.56	10	331	1.29	Quasi-peak	23.2	6.789	33.1	-26.3	Pass	
245.813	10	241	3.44	Quasi-peak	29.1	18.249	35.6	-17.4	Pass	
777.357	10	234	2.1	Quasi-peak	21.5	22.599	35.6	-13.0	Pass	
914.183	10	157	3.61	Quasi-peak	21.2	26.254	35.6	-9.3	Pass	
949.605	10	296	2.17	Quasi-peak	21	26.176	35.6	-9.4	Pass	

Professional Testing, EMI, Inc
Radiated Emissions, 10m Distance
30MHz - 1GHz Horizontal Polarity Measured Emissions

Corrected Quasi-peak Reading

Corrected Peak Value

Verified Low-PRF QP Reading

LPRF Verification Limit

LIM_Y Class B Peak

Operator: Eric Lifsey
17649 Run06b REChargeMode standard USB cable FCC-IC.ttl Mode: Charging
Power: 230/50
11:49:21 AM, Monday, January 18, 2016 Cable: Standard USB 1 m

EUT: PODS
Project Number: 17649-15
Client: Virtuix

≤ 1GHz Horizontal Antenna Polarity Measured Emissions

Table 7.3.3: Radiated Spurious Emissions, Receive Mode, Below 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 15.109 - Code of Federal Regulations Part 47, Subpart B - Unintentional Radiators, Radiated Emissions Limits							
Section:		15.109							
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 Results Data Sheet									
Page: 1 of 1									
EUT Line Voltage:		0 VDC		EUT Power Frequency:		0 N/A			
Antenna Orientation:		Vertical		Frequency Range:		Above 1GHz			
EUT Mode of Operation:					Charging 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
1946.03	3	173	1	Average	39.8	30.751	54.0	-23.2	Pass
2110.9	3	3	1	Average	35.7	26.854	54.0	-27.1	Pass
2465.6	3	28	1	Average	34.4	25.928	54.0	-28.0	Pass
4140	3	106	1	Average	33.5	28.401	54.0	-25.6	Pass
8561.42	3	111	1	Average	27	34.149	54.0	-19.8	Pass
12626.8	3	183	1	Average	27.6	38.168	54.0	-15.8	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 QP AVG

Operator: Eric Lifsey
17649 Run06b REChargeMode standard USB cable FCC-IC.tl Mode: Charging
12:43:43 PM, Monday, January 18, 2016 Power: 230/50
Cable: Standard USB 1 m

EUT: PODS
Project Number: 17649-15
Client: Virtuix

> 1GHz Vertical Antenna Polarity Measured Emissions

Table 7.3.4: Radiated Spurious Emissions, Receive Mode, Below 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 15.109 - Code of Federal Regulations Part 47, Subpart B - Unintentional Radiators, Radiated Emissions Limits								
Section:		15.109								
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 Results Data Sheet										Page: 1 of 1
EUT Line Voltage:		0 VDC			EUT Power Frequency:		0 N/A			
Antenna Orientation:		Horizontal			Frequency Range:		Above 1GHz			
EUT Mode of Operation:					Charging 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	
1982.37	3	99	1	Average	34.7	25.942	54.0	-28.0	Pass	
2503.65	3	245	1	Average	34.4	26.087	54.0	-27.9	Pass	
4233.61	3	138	1	Average	33.5	28.673	54.0	-25.3	Pass	
6953.51	3	292	1	Average	29.1	31.758	54.0	-22.2	Pass	
8538.54	3	246	1	Average	27.3	34.414	54.0	-19.5	Pass	
12109.4	3	259	1	Average	27.6	37.947	54.0	-16.0	Pass	

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

Operator: Eric Lifsey
17649 Run06b'REChargeModestandardUSBcableFCC+IC.tif Mode: Charging
12:43:43 PM, Monday, January 18, 2016 Power: 230/50
Cable: Standard USB 1 m

▽ Corrected Average Reading
— Corrected Peak Reading
— LIM_Y Class B Peak
— LIM_Y Class B QP AVG

EUT: PODS
Project Number: 17649-15
Client: Virtuix

> 1GHz 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.

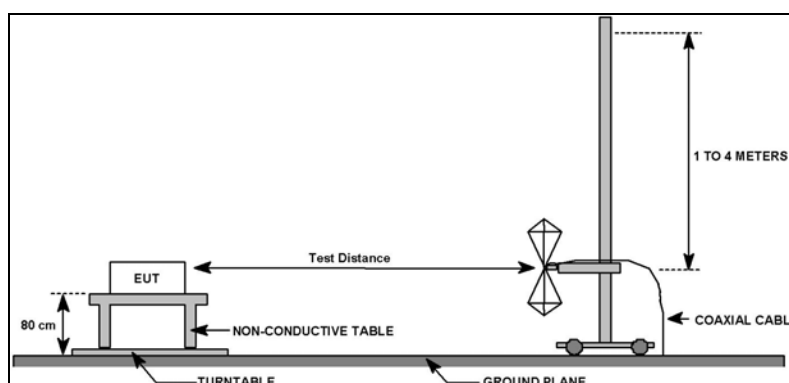


Figure 8.1.1: Field Strength of Spurious Emissions Test Setup

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	18 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):		1/18/2016			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 Results Data Sheet								Page: 1 of 1		
EUT Line Voltage:		0		VDC		EUT Power Frequency:		0		N/A
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	
31.0276	10	88	3.99	Quasi-peak	24.2	12.771	29.5	-16.7	Pass	
56.3039	10	198	2.78	Quasi-peak	24.6	6.791	29.5	-22.7	Pass	
60.0056	10	148	3.31	Quasi-peak	30.4	12.179	29.5	-17.3	Pass	
652.7	10	186	3.09	Quasi-peak	22	20.6	35.6	-15.0	Pass	
831.424	10	228	3.8	Quasi-peak	21.5	23.549	35.6	-12.1	Pass	
888.295	10	139	3.81	Quasi-peak	21.4	26.149	35.6	-9.5	Pass	

Professional Testing, EMI, Inc

Radiated Emissions, 10m Distance

30MHz - 1GHz Vertical Polarity Measured Emissions

Corrected Quasi-peak Reading

Corrected Peak Value

Verified Low-PRF QP Reading

LPRF Verification Limit

LIM_Y Class B Peak

PROFESSIONAL TESTING

Operator: Eric Lifsey

17649 Run08 RETxSpurious3ChhpFCC.tif

02:39:31 PM, Monday, January 18, 2016

Mode: Transmit, 3 Channels 2402/2440/2480 MHz

Power: Battery

Modulated

EUT: PODS

Project Number: 17649-15

Client: Virtuix

≤ 1GHz Vertical Antenna Polarity Measured Emissions

≤ 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):		1/18/2016			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 Results Data Sheet								Page: 1 of 1		
EUT Line Voltage:		0		VDC		EUT Power Frequency:		0		N/A
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	
34.6375	10	120	3.74	Quasi-peak	23.1	11.541	29.5	-18.0	Pass	
56.4334	10	278	1.41	Quasi-peak	23.7	5.834	29.5	-23.7	Pass	
761.369	10	207	1.98	Quasi-peak	21.7	22.647	35.6	-13.0	Pass	
796.307	10	281	2.81	Quasi-peak	21.5	23.038	35.6	-12.6	Pass	
943.059	10	254	2.63	Quasi-peak	21.1	26.214	35.6	-9.4	Pass	

Professional Testing, EMI, Inc
Radiated Emissions, 10m Distance
30MHz- 1GHzHorizontalPolarity Measured Emissions

Corrected Quasi-peak Reading
Corrected Peak Value
Verified Low-PRF OP Reading
LPRF Verification Limit
LIM_Y Class B Peak

Operator: Eric Lifsey
17649Run08RETxSpurious3ChnpfFCC.tif
02:39:31 PM,Monday, January 18, 2016

Mode: Transmit, 3 Channels 2402/2440/2480 MHz
Power: Battery
Modulated

EUT: PODS
Project Number: 17649-15
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):		1/18/2016			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 Results Data Sheet								Page: 1 of 1	
EUT Line Voltage:		0 VDC			EUT Power Frequency:		0 N/A		
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
4877.19	3	165	0	Average	32.8	29.012	54.0	-24.9	Pass
7326.79	3	186	0	Average	28.7	32.153	54.0	-21.8	Pass
9756.6	3	172	0	Average	26.4	33.33	54.0	-20.6	Pass
17071.1	3	124	0	Average	27.4	41.868	54.0	-12.1	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_QP_AVG

PROFESSIONAL TESTING

Operator: Eric Lifsey

17649 Run08 RETxSpurious3 Ch1hpFCC.tif

03:46:20 PM, Monday, January 18, 2016

Mode: Transmit, 3 Channels 2402/2440/2480 MHz

Power: Battery

Modulated

EUT: PODS

Project Number: 17649-15

Client: Virtuix

1 to 18 GHz Vertical Antenna Polarity Measured Emissions

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):		1/18/2016			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 Results Data Sheet							Page: 1 of 1			
EUT Line Voltage:		0		VDC		EUT Power Frequency:		0		N/A
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	
4875.45	3	75	0	Average	32.8	29.014	54.0	-24.9	Pass	
7310.26	3	38	0	Average	28.5	31.948	54.0	-22.0	Pass	
9768.54	3	344	0	Average	26.4	33.316	54.0	-20.6	Pass	
17070.2	3	115	0	Average	27.4	41.863	54.0	-12.1	Pass	

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

Corrected Average Reading

Corrected Peak Reading

LIM_Y_Class_B_Peak

LIM_Y_Class_B_QP_AVG

Operator: Eric Lifsey
17649Run08RETxSpurious3Ch'hpFCC.ttl
03:46:20 PM, Monday, January 18, 2016

Mode: Transmit, 3 Channels 2402/2440/2480 MHz
Power: Battery
Modulated

EUT: PODS
Project Number: 17649-15
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, 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):		1/18/2016		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 Results Data Sheet								Page: 1 of 1	
EUT Line Voltage:		0 VDC		EUT Power Frequency:		0 N/A			
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
19505.9	3	26	1	Average	33.4	29.498	54.0	-24.5	Pass
24396.6	3	319	1	Average	34.3	33.716	54.0	-20.2	Pass

Professional Testing, EMI, Inc
Radiated Emissions, Measured at 1m and Scaled to 3m Distance
18-26.5 GHz Vertical Polarity Measured Emissions

Operator: Eric Lifsey
17649 Run08 RETxSpurious3Ch.hpfTCC.dll
04:31:01 PM, Monday, January 18, 2016

Frequency

Mode: Transmit, 3 Channels 2402/2440/2480 MHz
Power: Battery
Modulated

EUT: PODS
Project Number: 17649-15
Client: Virtuix

> 18 GHz Vertical Antenna Polarity Measured Emissions

Table 8.3.6: Radiated Spurious Emissions, Transmit Mode, 18 to 26 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):		1/18/2016		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 Results Data Sheet								Page: 1 of 1	
EUT Line Voltage:		0 VDC		EUT Power Frequency:		0 N/A			
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
19524.8	3	78	1	Average	33.3	29.468	54.0	-24.5	Pass
24398.1	3	156	1	Average	34.3	33.757	54.0	-20.2	Pass

Professional Testing, EMI, Inc
Radiated Emissions, Measured at 1m and Scaled to 3m Distance
18-26.5 GHz Horizontal Polarity Measured Emissions

Operator: Eric Lifsey
17649 Run08 RETxSpurious3Ch.hpfTCC.dll
04:31:01 PM, Monday, January 18, 2016

Frequency

EUT: PODS
Project Number: 17649-15
Client: Virtuix

Mode: Transmit, 3 Channels 2402/2440/2480 MHz
Power: Battery
Modulated

> 18 GHz Horizontal Antenna Polarity Measured Emissions

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	18 Jan 2016

9.3 Results

Table 9.3.1 Antenna Construction Details	
Antenna Manufacturer and Model	Specifications
Manufacturer: Johanson Technology, Inc. Model: P/N 2450AT18A100	Chip antenna. Peak gain: 0.5 dBi* Average gain: -0.5 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
1735	Pasternack	PE9850-20	Antenna, horn, WR28	N/A	N/A
1974	Agilent	83017A	Amplifier, Microwave 0.5-26.5 GHz	MY39500684	12/17/2017

10.2 Equipment for Bandwidth and Timings

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

10.3 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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