



## **MET Laboratories, Inc.** *Safety Certification - EMI - Telecom Environmental Simulation*

914 WEST PATAPSCO AVENUE • BALTIMORE, MARYLAND 21230-3432 • PHONE (410) 354-3300 • FAX (410) 354-3313

33439 WESTERN AVENUE • UNION CITY, CALIFORNIA 94587 • PHONE (510) 489-6300 • FAX (510) 489-6372

3162 BELICK STREET • SANTA CLARA, CA 95054 • PHONE (408) 748-3585 • FAX (510) 489-6372

13301 MCCALLEN PASS ! AUSTIN, TX 78753 ! PHONE (512) 287-2500 ! FAX (512) 287-2513

February 20, 2012

OnBoard Research Corp.  
1321 Valwood Pkwy, STE 440  
Carrollton, TX 75006

Dear Arthur Harvey,

Enclosed is the EMC Wireless test report for compliance testing of the OnBoard Research Corp., Intellitouch Freedom One, Base Unit Model #WT1P as tested to the requirements of Title 47 of the CFR, Ch. 1 (10-1-06 ed.), Part 15, Subpart B, ICES-003, Issue 4 February 2004 for a Class B Digital Device and FCC Part 15 Subpart C, RSS-210, Issue 8, December 2010 for Intentional Radiators.

Thank you for using the services of MET Laboratories, Inc. If you have any questions regarding these results or if MET can be of further service to you, please feel free to contact me.

Sincerely yours,  
MET LABORATORIES, INC.

Jennifer Warnell  
Documentation Department

Reference: (\OnBoard Research Corp.\EMCA33531A-FCC249 Rev. 1)

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OnBoard Research Corp.  
Intellitouch Freedom One, Base Unit Model #WT1P

Electromagnetic Compatibility  
Cover Page  
CFR Title 47, Part 15B, 15.249; RSS-210, Issue 8, December 2010 & ICES-003

## Electromagnetic Compatibility Criteria Test Report

for the

**OnBoard Research Corp.  
Intellitouch Freedom One, Base Unit Model #WT1P**

Verified under  
the FCC Certification Rules  
contained in  
Title 47 of the CFR, Parts 15 Subpart B & ICES-003  
for Class B Digital Devices  
&  
15.249 Subpart C & RSS-210, Issue 8, December 2010  
for Intentional Radiators

**MET Report: EMCA33531A-FCC249 Rev. 1**

February 20, 2012

**Prepared For:**

**OnBoard Research Corp.  
1321 Valwood Pkwy, STE 440  
Carrollton, TX 75006**

**Prepared By:**  
**MET Laboratories, Inc.**  
914 W. Patapsco Ave.  
Baltimore, MD 21230

## Electromagnetic Compatibility Criteria Test Report

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**OnBoard Research Corp.  
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### Tested Under

the FCC Certification Rules  
contained in  
Title 47 of the CFR, Parts 15 Subpart B & ICES-003  
for Class B Digital Devices  
&  
15.249 Subpart C & RSS-210, Issue 8, December 2010  
for Intentional Radiators



Ram Shrestha, Project Engineer  
Electromagnetic Compatibility Lab



Jennifer Warnell  
Documentation Department

**Engineering Statement:** The measurements shown in this report were made in accordance with the procedures indicated, and the emissions from this equipment were found to be within the limits applicable. I assume full responsibility for the accuracy and completeness of these measurements, and for the qualifications of all persons taking them. It is further stated that upon the basis of the measurements made, the equipment tested is capable of operation in accordance with the requirements of the FCC Rules Parts 15B, 15.249 and Industry Canada standards ICES-003, Issue 4 February 2004, RSS-210, Issue 8, December 2010 under normal use and maintenance.



Shawn McMillen, Wireless Manager  
Electromagnetic Compatibility Lab



OnBoard Research Corp.  
Intellitouch Freedom One, Base Unit Model #WT1P

Electromagnetic Compatibility  
Report Status  
CFR Title 47, Part 15B, 15.249; RSS-210, Issue 8, December 2010 & ICES-003

## Report Status Sheet

Revision	Report Date	Reason for Revision
Ø	February 13, 2012	Initial Issue.
1	February 20, 2012	Revised to reflect editorial correction

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OnBoard Research Corp.

Intellitouch Freedom One, Base Unit Model #WT1P

Electromagnetic Compatibility  
List of Terms and Abbreviations

CFR Title 47, Part 15B, 15.249; RSS-210, Issue 8, December 2010 & ICES-003

## List of Terms and Abbreviations

<b>AC</b>	Alternating Current
<b>ACF</b>	Antenna Correction Factor
<b>Cal</b>	Calibration
<i>d</i>	Measurement Distance
<b>dB</b>	Decibels
<b>dB<math>\mu</math>A</b>	Decibels above one <b>microamp</b>
<b>dB<math>\mu</math>V</b>	Decibels above one <b>microvolt</b>
<b>dB<math>\mu</math>A/m</b>	Decibels above one <b>microamp per meter</b>
<b>dB<math>\mu</math>V/m</b>	Decibels above one <b>microvolt per meter</b>
<b>DC</b>	Direct Current
<b>E</b>	Electric Field
<b>DSL</b>	Digital Subscriber Line
<b>ESD</b>	Electrostatic Discharge
<b>EUT</b>	Equipment Under Test
<i>f</i>	Frequency
<b>FCC</b>	Federal Communications Commission
<b>GRP</b>	Ground Reference Plane
<b>H</b>	Magnetic Field
<b>HCP</b>	Horizontal Coupling Plane
<b>Hz</b>	Hertz
<b>IEC</b>	International Electrotechnical Commission
<b>kHz</b>	kilohertz
<b>kPa</b>	kilopascal
<b>kV</b>	kilovolt
<b>LISN</b>	Line Impedance Stabilization Network
<b>MHz</b>	Megahertz
<b><math>\mu</math>H</b>	<b>microhenry</b>
<b><math>\mu</math>F</b>	<b>microfarad</b>
<b><math>\mu</math>s</b>	<b>microseconds</b>
<b>PRF</b>	Pulse Repetition Frequency
<b>RF</b>	Radio Frequency
<b>RMS</b>	Root-Mean-Square
<b>TWT</b>	Traveling Wave Tube
<b>V/m</b>	Volts <b>per meter</b>
<b>VCP</b>	Vertical Coupling Plane



**MET®**  
OnBoard Research Corp.

Intellitouch Freedom One, Base Unit Model #WT1P

Electromagnetic Compatibility  
Executive Summary

CFR Title 47, Part 15B, 15.249; RSS-210, Issue 8, December 2010 & ICES-003

## I. Executive Summary

## A. Purpose of Test

An EMC evaluation was performed to determine compliance of the OnBoard Research Corp. Intellitouch Freedom One, Base Unit Model #WT1P, with the requirements of Part 15, §15.249. All references are to the most current version of Title 47 of the Code of Federal Regulations in effect. In accordance with §2.1033, the following data is presented in support of the Certification of the Intellitouch Freedom One, Base Unit Model #WT1P. OnBoard Research Corp. should retain a copy of this document which should be kept on file for at least two years after the manufacturing of the Intellitouch Freedom One, Base Unit Model #WT1P, has been **permanently** discontinued.

## B. Executive Summary

The following tests were conducted on a sample of the equipment for the purpose of demonstrating compliance with Part 15, §15.249, in accordance with OnBoard Research Corp., purchase order number T00842. All tests were conducted using measurement procedure ANSI C63.4-2003.

FCC Reference	Canada Reference	Description	Results
15.107	ICES-003	AC Power Line Conducted Emissions	Compliant
15.109	ICES-003	Radiated Emissions	Compliant
§15.203	RSS GEN §7.1.2	Antenna Requirement	Compliant
§15.207	RSS GEN §7.2.4	AC Power Line Conducted Emissions	Compliant
§15.249 (a)	RSS-210 A2.9	Field Strength of Fundamental	Compliant
§15.249(a)(d), §15.209	RSS-Gen §7.2.5 and RSS-210 A2.0	Harmonics and Spurious Emissions	Compliant
§15.215 (c)	RSS GEN §4.6.1	20 dB and 99% Bandwidth	Compliant
N/A	RSS-GEN §6.2	Receiver Spurs	Compliant

**Table 1. Executive Summary of EMC Part 15.249 Compliance Testing**

## II. Equipment Configuration

## A. Overview

MET Laboratories, Inc. was contracted by OnBoard Research Corp. to perform testing on the Intellitouch Freedom One, Base Unit Model #WT1P, under OnBoard Research Corp.'s purchase order number T00842.

This document describes the test setups, test methods, required test equipment, and the test limit criteria used to perform compliance testing of the OnBoard Research Corp., Intellitouch Freedom One, Base Unit Model #WT1P.

The results obtained relate only to the item(s) tested.

<b>Model(s) Tested:</b>	Intellitouch Freedom One, Base Unit Model #WT1P	
	Primary Power to Module: 9 V Battery; Current 60mA	
	FCC ID: A66-FREEDOM-002 IC: 10178A-FREEDOM002	
<b>EUT Specifications:</b>	Type of Modulations:	8 FSK
	Equipment Code:	DXX
	EUT Frequency Ranges:	2406 – 2474 MHz
<b>Analysis:</b>	The results obtained relate only to the item(s) tested.	
<b>Environmental Test Conditions:</b>	Temperature (15-35° C) Relative Humidity (30-60%) Barometric Pressure (860-1060 mbar)	
<b>Evaluated by:</b>	Ram Shrestha	
<b>Report Date(s):</b>	February 20, 2012	

**Table 2. EUT Specifications**



OnBoard Research Corp.

Intellitouch Freedom One, Base Unit Model #WT1P

Electromagnetic Compatibility  
Equipment Configuration

CFR Title 47, Part 15B, 15.249; RSS-210, Issue 8, December 2010 & ICES-003

## B. References

<b>CFR 47, Part 15, Subpart C</b>	Federal Communication Commission, Code of Federal Regulations, Title 47, Part 15: General Rules and Regulations, Allocation, Assignment, and Use of Radio Frequencies
<b>CFR 47, Part 15, Subpart B</b>	Electromagnetic Compatibility: Criteria for Radio Frequency Devices
<b>RSS-210, Issue 8, December 2010</b>	Low-power Licence-exempt Radiocommunications Devices (All Frequency Bands): Category I Equipment
<b>ICES-003, Issue 4 February 2004</b>	Electromagnetic Compatibility: Criteria for Radio Frequency Devices
<b>ANSI C63.4:2003</b>	Methods and Measurements of Radio-Noise Emissions from Low-Voltage Electrical And Electronic Equipment in the Range of 9 kHz to 40 GHz
<b>ANSI/NCSL Z540-1-1994</b>	Calibration Laboratories and Measuring and Test Equipment - General Requirements
<b>ANSI/ISO/IEC 17025:2005</b>	General Requirements for the Competence of Testing and Calibration Laboratories
<b>ANSI C63.10-2009</b>	American National Standard for Testing Unlicensed Wireless Devices

## C. Test Site

All testing was performed at MET Laboratories, Inc., 13301 McCallen Pass, Austin, TX 78753. All equipment used in making physical determinations is accurate and bears recent traceability to the National Institute of Standards and Technology.

Radiated Emissions measurements were performed in a semi-anechoic chamber (equivalent to an Open Area Test Site). In accordance with §2.948(a)(3), a complete site description is contained at MET Laboratories.

## D. Description of Test Sample

The Base Unit (EUT) is one component in a 2.4GHz digital wireless system for electronic musical instruments such as guitar. The system consists of two electronic transceivers; the “Instrument Transceiver” connects to the instrument, digitizes the analog signal from the instrument, and transmits it to the “Base Unit” (EUT). The Base Unit transceiver receives the digital information from the Instrument Transceiver, reconstructs an analog signal, and provides the analog signal output on a standard 1/4” phone jack. The Base Unit also contains circuitry that analyzes the fundamental frequency of the analog signal, converts the result into a musical representation (note + sharp/flat indication), and optionally displays that information on a LED-backlit LCD for the user to tune their instrument or monitor their performance.

## E. Equipment Configuration

Ref. ID	Name / Description	Model Number	Serial Number
0002	Base Unit	WT1P	N/A

**Table 3. Equipment Configuration**

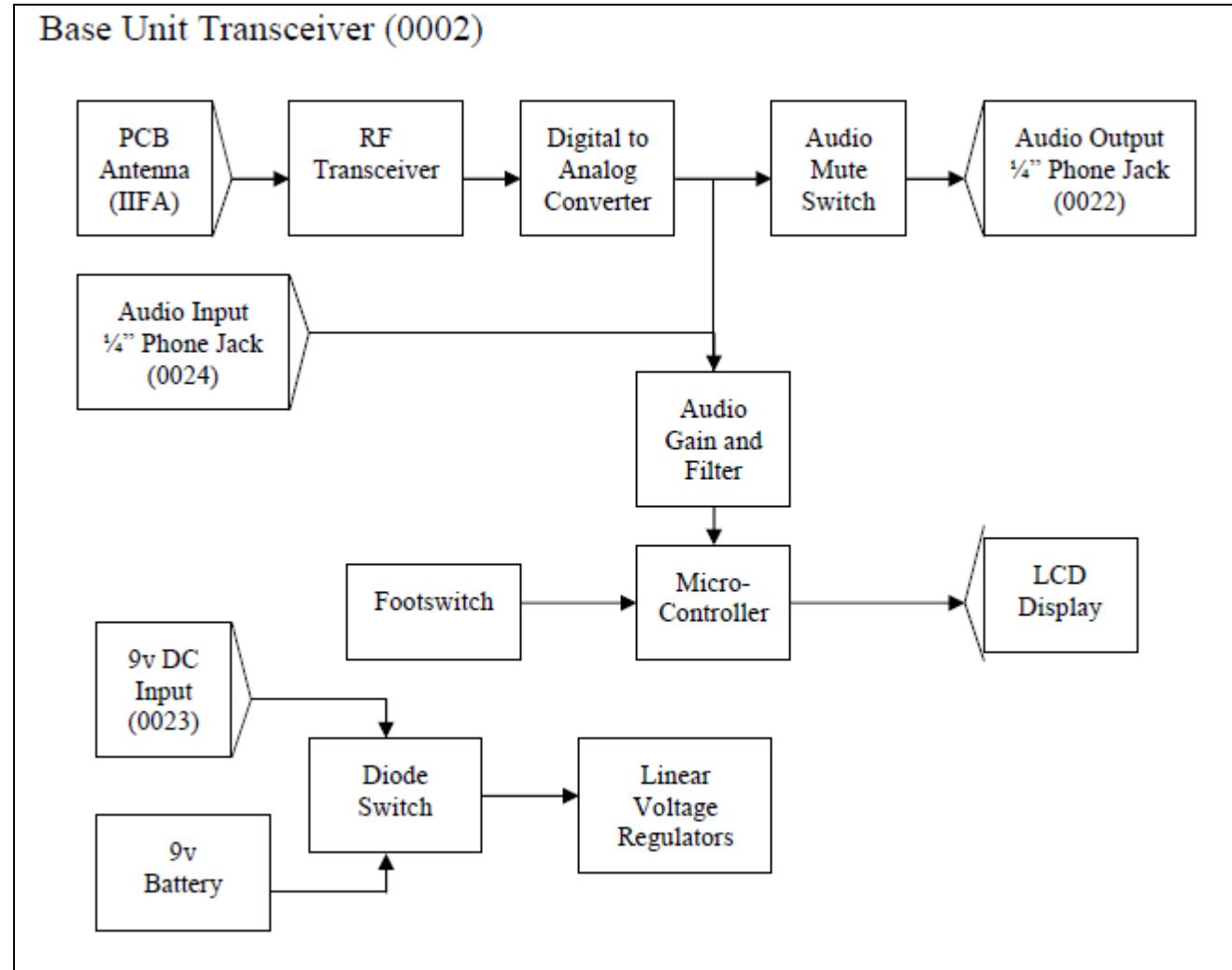
## F. Support Equipment

Ref. ID	Name / Description	Manufacturer	Model Number	Serial Number
0011	DC Power Supply (9v)	Ahead	ADA-0900300	0001

**Table 4. Support Equipment**

## G. Ports and Cabling Information

Ports and cabling information was not required.



**Figure 1. Block Diagram of Test Configuration**



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Intellitouch Freedom One, Base Unit Model #WT1P

Electromagnetic Compatibility  
Equipment Configuration  
CFR Title 47, Part 15B, 15.249; RSS-210, Issue 8, December 2010 & ICES-003

## **H. Mode of Operation**

The EUT is simulating normal operation by transmission of a modulated signal, configured through software assignment to each of three channels: 2406 MHz (lowest channel), 2440 MHz (middle channel), and 2474 MHz (highest channel).

## **I. Modifications**

### **a) Modifications to EUT**

No modifications were made to the EUT.

### **b) Modifications to Test Standard**

No modifications were made to the test standard.

## **J. Disposition of EUT**

The test sample including all support equipment submitted to the Electro-Magnetic Compatibility Lab for testing was returned to OnBoard Research Corp. upon completion of testing.



OnBoard Research Corp.

Intellitouch Freedom One, Base Unit Model #WT1P

Electromagnetic Compatibility  
Unintentional Radiators

CFR Title 47, Part 15B, 15.249; RSS-210, Issue 8, December 2010 & ICES-003

### **III. Electromagnetic Compatibility Criteria for Unintentional Radiators**

## Electromagnetic Compatibility Criteria for Unintentional Radiators

### § 15.107 Conducted Emissions Limits

**Test Requirement(s):** **15.107 (a)** Except for Class A digital devices, for equipment that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz to 30 MHz shall not exceed the limits in Table 5. Compliance with this provision shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminals.

**15.107 (b)** For a Class A digital device that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz to 30 MHz shall not exceed the limits in Table 5. Compliance with this provision shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminals. The lower limit applies at the band edges.

Frequency range (MHz)	Class A Conducted Limits (dB $\mu$ V)		*Class B Conducted Limits (dB $\mu$ V)	
	Quasi-Peak	Average	Quasi-Peak	Average
* 0.15- 0.45	79	66	66 - 56	56 - 46
0.45 - 0.5	79	66	56	46
0.5 - 30	73	60	60	50

Note 1 — The lower limit shall apply at the transition frequencies.  
 Note 2 — The limit decreases linearly with the logarithm if the frequency in the range 0.15 MHz to 0.5 MHz.  
 \* -- Limits per Subsection 15.207(a).

**Table 5. Conducted Limits for Radio Frequency Devices calculated from FCC Part 15 Subsections 15.107(a) (b)**

**Test Results:** The EUT was compliant with the Class B requirement(s) of this section. Measured emissions were below applicable limits.

**Test Technician(s):** Oscar Moreno

**Test Date(s):** 12/15/11



OnBoard Research Corp.

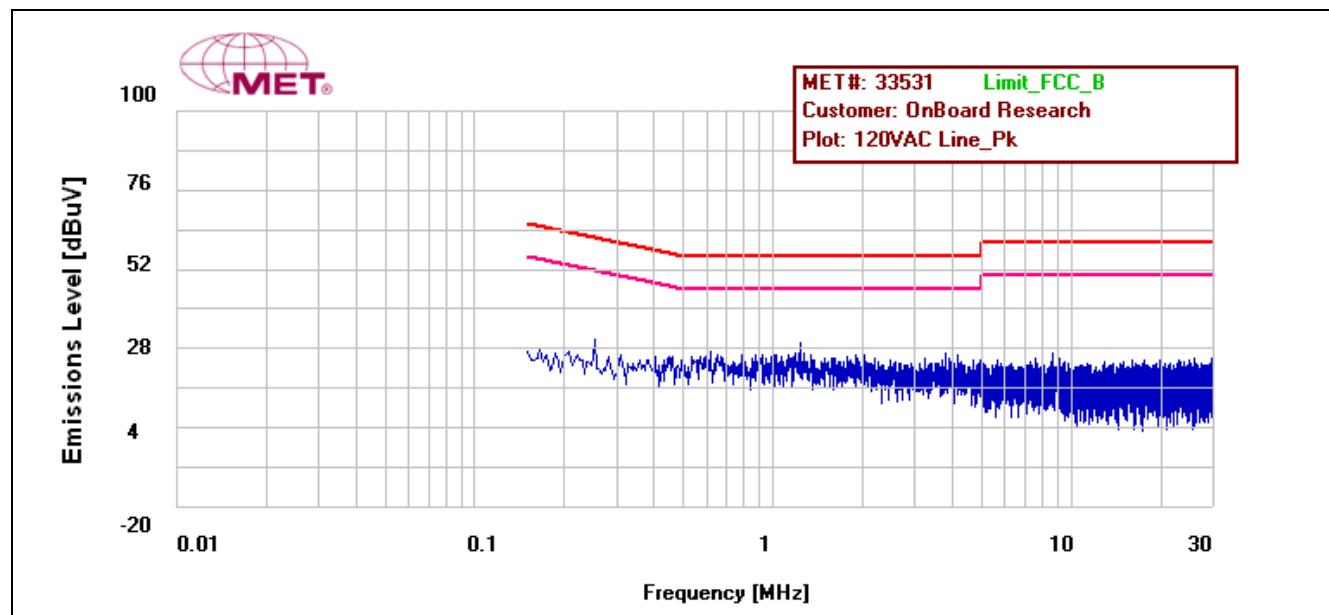
Intellitouch Freedom One, Base Unit Model #WT1P

Electromagnetic Compatibility  
Unintentional Radiators

CFR Title 47, Part 15B, 15.249; RSS-210, Issue 8, December 2010 & ICES-003

Line	Freq (MHz)	QP Amplitude	QP Limit	Delta	Pass	Average Amplitude	Average Limit	Delta	Pass
120VAC Line	.204	25.23	63.453	-38.223	Pass	21.23	53.453	-32.223	Pass
120VAC Line	1.392	23.23	56	-32.77	Pass	20.93	46	-25.07	Pass
120VAC Line	3.108	21.53	56	-34.47	Pass	20.78	46	-25.22	Pass

Table 6. Conducted Emissions, Phase Line, Test Results



Plot 1. Conducted Emissions, Phase Line



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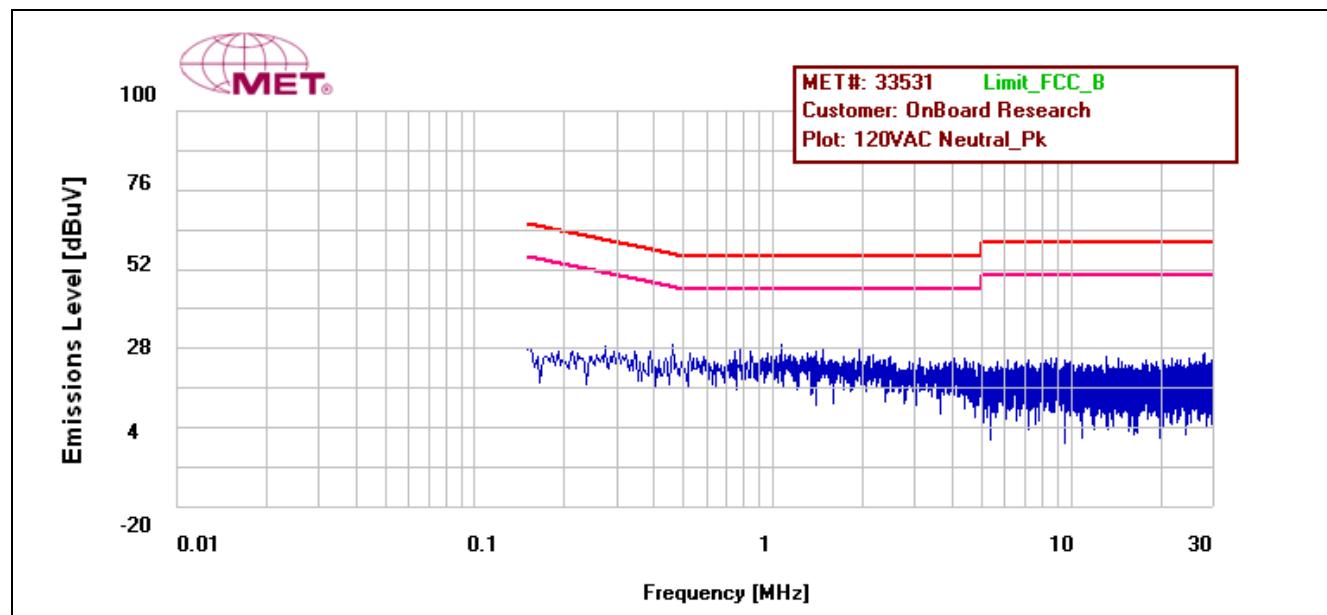
Intellitouch Freedom One, Base Unit Model #WT1P

Electromagnetic Compatibility  
Unintentional Radiators

CFR Title 47, Part 15B, 15.249; RSS-210, Issue 8, December 2010 & ICES-003

Line	Freq (MHz)	QP Amplitude	QP Limit	Delta	Pass	Average Amplitude	Average Limit	Delta	Pass
120VAC Neutral	.412	22.78	57.631	-34.851	Pass	21	47.631	-26.631	Pass
120VAC Neutral	.716	22.23	56	-33.77	Pass	20.96	46	-25.04	Pass
120VAC Neutral	1.320	23.4	56	-32.6	Pass	21	46	-25	Pass

Table 7. Conducted Emissions, Neutral Line, Test Results



Plot 2. Conducted Emissions, Neutral Line

## Radiated Emission Limits

### § 15.109 Radiated Emissions Limits

**Test Requirement(s):** **15.109 (a)** Except for Class A digital devices, the field strength of radiated emissions from unintentional radiators at a distance of 3 meters shall not exceed the Class B limits expressed in Table 8.

**15.109 (b)** The field strength of radiated emissions from a Class A digital device, as determined at a distance of 10 meters, shall not exceed the Class A limits expressed in Table 8.

Frequency (MHz)	Field Strength (dB $\mu$ V/m)	
	§15.109 (b), Class A Limit (dB $\mu$ V) @ 10m	§15.109 (a), Class B Limit (dB $\mu$ V) @ 3m
30 - 88	39.00	40.00
88 - 216	43.50	43.50
216 - 960	46.40	46.00
Above 960	49.50	54.00

**Table 8. Radiated Emissions Limits calculated from FCC Part 15, §15.109 (a) (b)**

**Test Procedures:** The EUT was placed on a 0.8m-high acrylic table inside a semi-anechoic chamber. The method of testing and test conditions of ANSI C63.4 were used. An antenna was located 10 m from the EUT on an adjustable mast. A pre-scan was first performed in order to find prominent radiated emissions. For final emissions measurements at each frequency of interest, the EUT was rotated and the antenna height was varied between 1 m and 4 m in order to maximize the emission. Measurements in both horizontal and vertical polarities were made and the data was recorded. Unless otherwise specified, measurements were made using a quasi-peak detector with a 120 kHz Resolution bandwidth.

**Test Results:** The EUT was found compliant with the Class B requirement(s) of this section. Measured emissions were below applicable limits.

**Test Technician(s):** Oscar Moreno

**Test Date(s):** 12/15/11



OnBoard Research Corp.

Intellitouch Freedom One, Base Unit Model #WT1P

Electromagnetic Compatibility

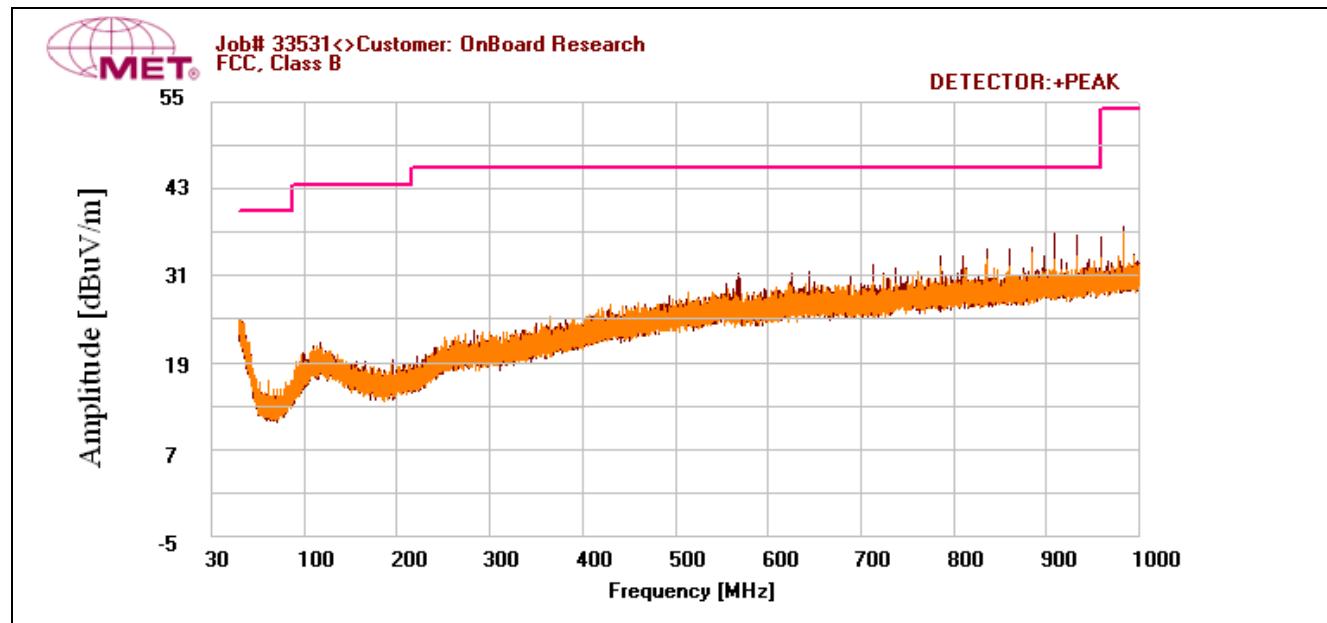
Unintentional Radiators

CFR Title 47, Part 15B, 15.249; RSS-210, Issue 8, December 2010 & ICES-003

## Radiated Emissions Limits Test Results, Class B

Frequency (MHz)	Antenna Polarity	EUT Azimuth (Degrees)	Antenna Height (cm)	Uncorrected Amplitude (dBuV)	ACF (dB/m)	Pre Amp Gain (dB)	CBL (dB)	DCF (dB)	Corrected Amplitude (dBuV)	Limit (dBuV)	Margin (dB)
909.348	H	187	256	25.52	20.191	18.635	0	10.46	37.536	46	-8.464
933.922	H	184	243	24.95	20.278	18.382	0	10.46	37.306	46	-8.694
958.477	H	219	249	24.01	20.521	18.15	0	10.46	36.841	46	-9.159
983.05	H	195	235	24.98	20.66	18.05	0	10.46	38.05	54	-15.95
835.589	H	166	234	21.51	19.748	19.197	0	10.46	32.521	46	-13.479
860.202	H	189	266	22.28	19.821	19.037	0	10.46	33.524	46	-12.476

Table 9. Radiated Emissions Limits, Test Results, FCC Limits



Plot 3. Radiated Emissions, Pre-Scan, 30 MHz – 1 GHz, FCC Limits



OnBoard Research Corp.

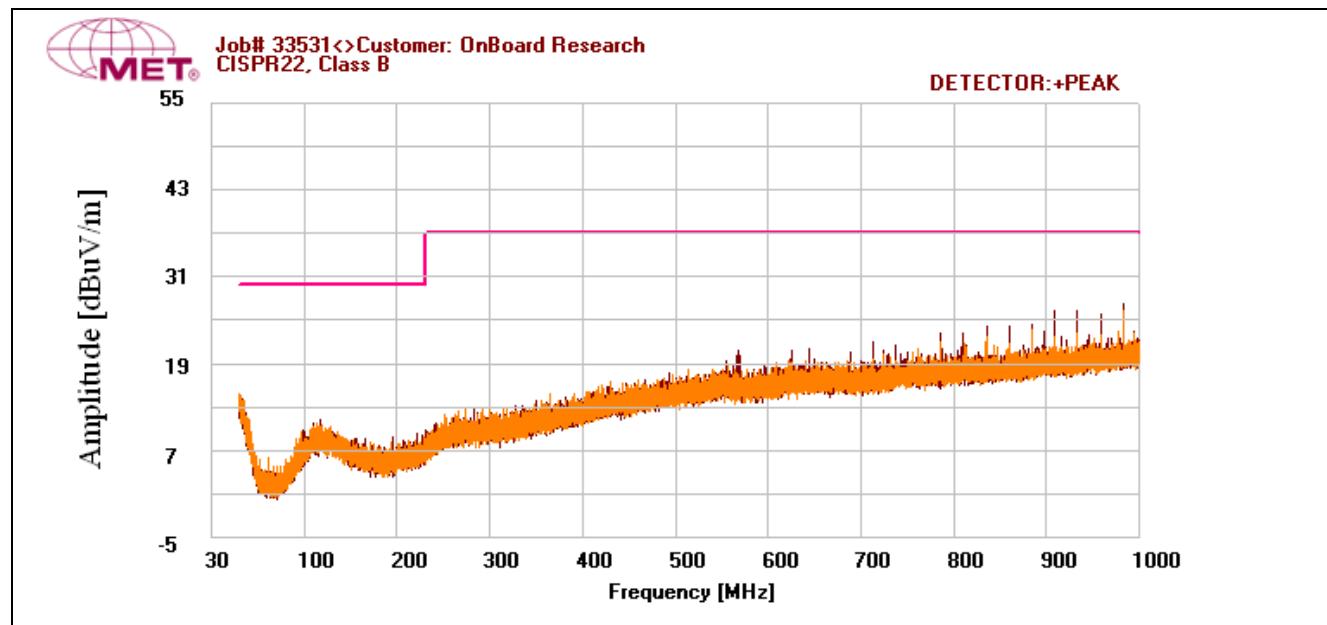
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Electromagnetic Compatibility  
Unintentional Radiators

CFR Title 47, Part 15B, 15.249; RSS-210, Issue 8, December 2010 & ICES-003

Frequency (MHz)	Antenna Polarity	EUT Azimuth (Degrees)	Antenna Height (cm)	Uncorrected Amplitude (dBuV)	ACF (dB/m)	Pre Amp Gain (dB)	CBL (dB)	DCF (dB)	Corrected Amplitude (dBuV)	Limit (dBuV)	Margin (dB)
909.348	H	187	256	25.52	20.191	18.635	0	0	27.076	37	-9.924
933.922	H	184	243	24.95	20.278	18.382	0	0	26.846	37	-10.154
958.477	H	219	249	24.01	20.521	18.15	0	0	26.381	37	-10.619
983.05	H	195	235	24.98	20.66	18.05	0	0	27.59	37	-9.41
835.589	H	166	234	21.51	19.748	19.197	0	0	22.061	37	-14.939
860.202	H	189	266	22.28	19.821	19.037	0	0	23.064	37	-13.936

Table 10. Radiated Emissions Limits, Test Results, ICES-003 Limits



Plot 4. Radiated Emissions, Pre-Scan, ICES-003 Limits



OnBoard Research Corp.

Intellitouch Freedom One, Base Unit Model #WT1P

Electromagnetic Compatibility  
Intentional Radiators

CFR Title 47, Part 15B, 15.249; RSS-210, Issue 8, December 2010 & ICES-003

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## IV. Electromagnetic Compatibility Criteria for Intentional Radiators

## Electromagnetic Compatibility Criteria for Intentional Radiators

### § 15.203 Antenna Requirement

**Test Requirement:**

**§ 15.203:** An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited.

The structure and application of the EUT were analyzed to determine compliance with Section 15.203 of the Rules. Section 15.203 states that the subject device must meet at least one of the following criteria:

- a.) Antenna must be permanently attached to the unit.
- b.) Antenna must use a unique type of connector to attach to the EUT.
- c.) Unit must be professionally installed. Installer shall be responsible for verifying that the correct antenna is employed with the unit.

**Test Results:** The EUT is compliant with §15.203. The EUT has an integral wire antenna.

**Test Engineer(s):** Ram Shrestha

**Test Date(s):** 12/15/11

## Electromagnetic Compatibility Criteria for Intentional Radiators

### § 15.207 Conducted Emissions Limits

**Test Requirement(s):** **§ 15.207 (a):** For an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies, within the band 150 kHz to 30MHz, shall not exceed the limits in the following table, as measured using a 50  $\mu$ H/50  $\Omega$  line impedance stabilization network (LISN). Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower limit applies at the boundary between the frequency ranges.

Frequency range (MHz)	§ 15.207(a), Conducted Limit (dB $\mu$ V)	
	Quasi-Peak	Average
* 0.15- 0.45	66 - 56	56 - 46
0.45 - 0.5	56	46
0.5 - 30	60	50

**Table 11. Conducted Limits for Intentional Radiators from FCC Part 15 § 15.207(a)**

**Test Procedure:**

The EUT was placed on a 0.8 m-high wooden table inside a screen room. The EUT was situated such that the back of the EUT was 0.4 m from one wall of the vertical ground plane, and the remaining sides of the EUT were no closer than 0.8 m from any other conductive surface. The EUT was powered from a 50  $\Omega$ /50  $\mu$ H Line Impedance Stabilization Network (LISN). The EMC receiver scanned the frequency range from 150 kHz to 30 MHz. Conducted Emissions measurements were made in accordance with *ANSI C63.4-2003 "Methods and Measurements of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9kHz to 40 GHz"*. The measurements were performed over the frequency range of 0.15 MHz to 30 MHz using a 50  $\Omega$ /50  $\mu$ H LISN as the input transducer to an EMC/field intensity meter. For the purpose of this testing, the transmitter was turned on. Scans were performed with the transmitter on.

**Test Results:**

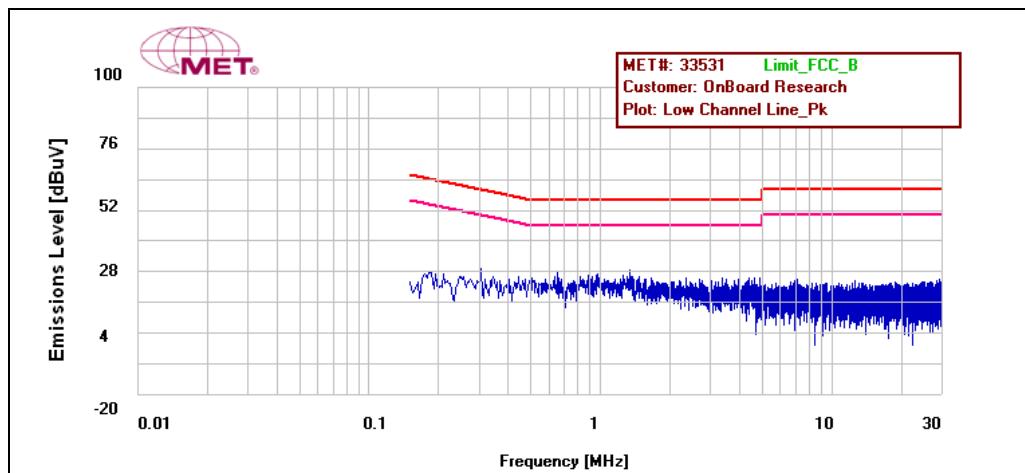
The EUT was compliant with this requirement. Measured emissions were below applicable limits.

**Test Technician(s):**

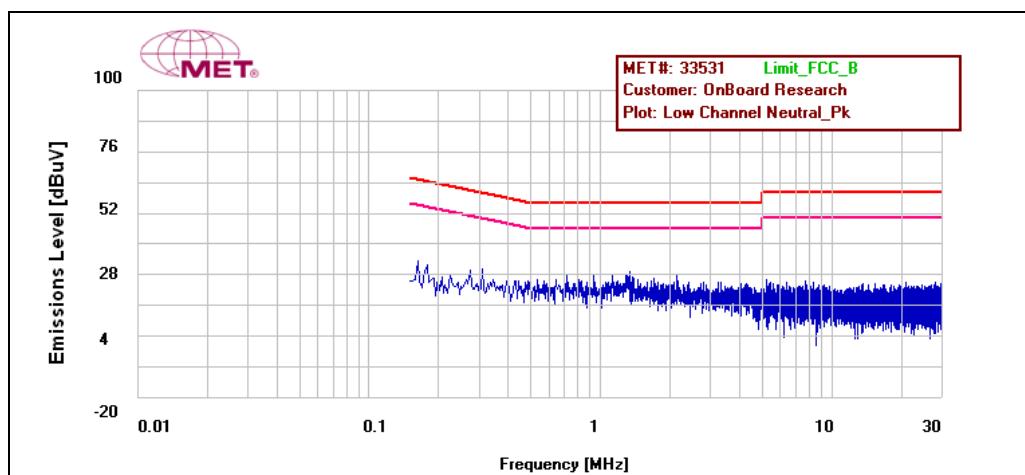
Oscar Moreno

**Test Date(s):**

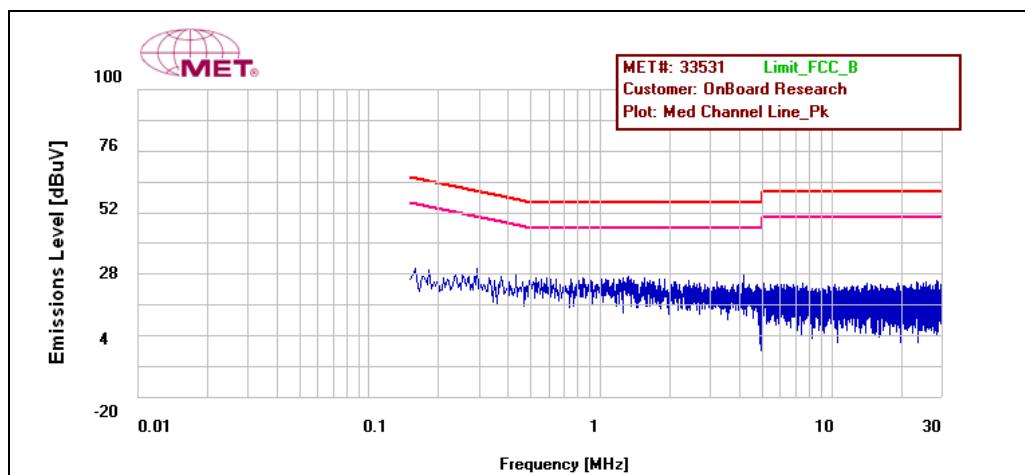
12/15/11



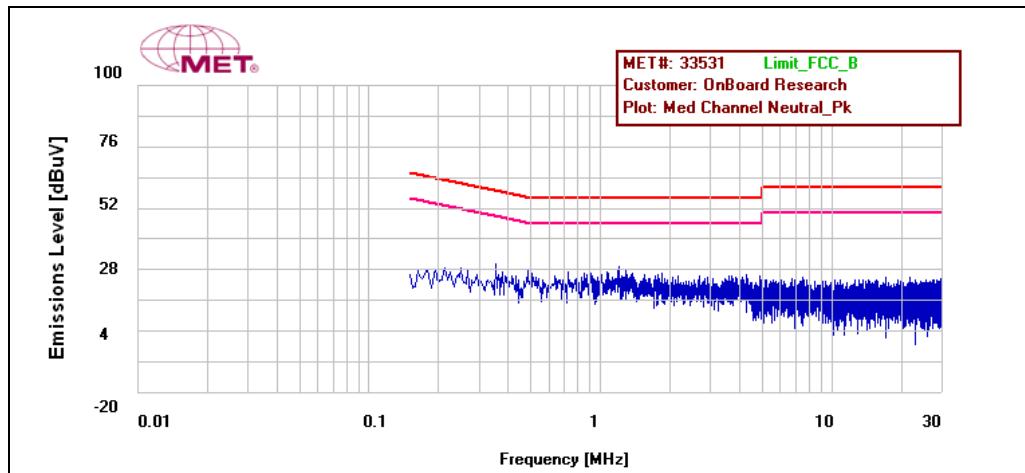
Plot 5. 15.207 Conducted Emissions, Low Channel Line



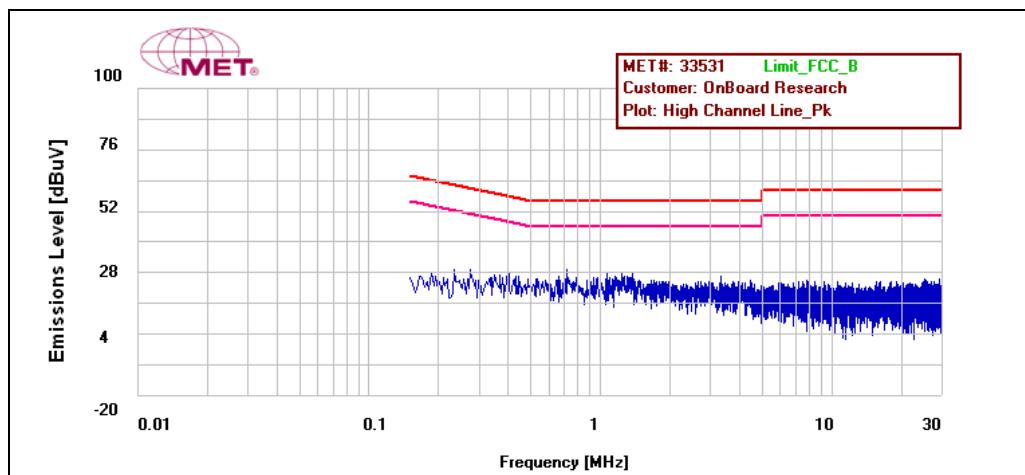
Plot 6. 15.207 Conducted Emissions, Low Channel Neutral



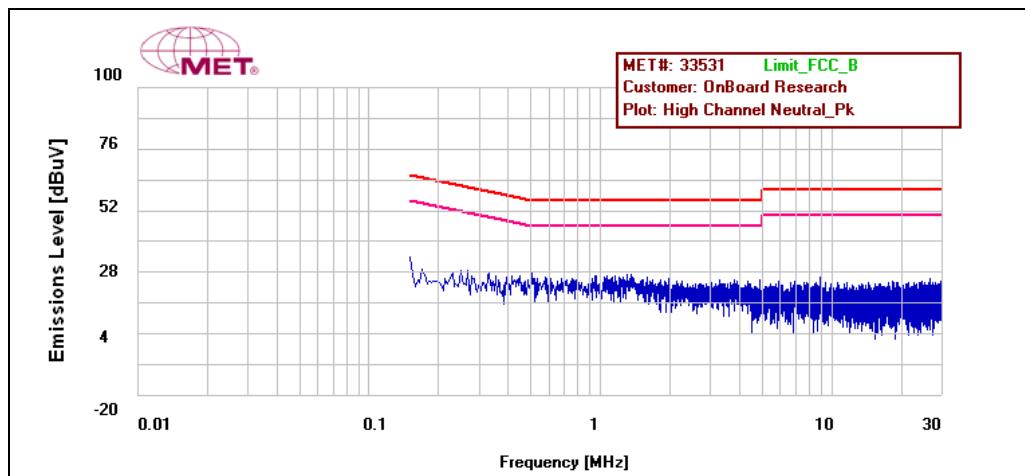
Plot 7. 15.207 Conducted Emissions, Mid Channel Line



Plot 8. 15.207 Conducted Emissions, Mid Channel Neutral



Plot 9. 15.207 Conducted Emissions, High Channel Line



Plot 10. 15.207 Conducted Emissions, High Channel Neutral



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## Electromagnetic Compatibility Criteria for Intentional Radiators

### § 15.249(a) Radiated Field Strength of Fundamental

**Test Requirements:**

**§ 15.249(a):** The 3 meter field strength of the fundamental emissions from intentional radiators operated within the 2400 – 4283.5 MHz frequency bands shall comply with the following requirement: 50 millivolts/meter (94dB $\mu$ V/m), quasi-peak mode measurement.

Fundamental Frequency	Field Strength of Fundamental (millivolts/meter)	Field Strength of Harmonics (microvolts/meter)
902 – 928 MHz	50	500
2400 – 2483.5 MHz	50	500
5725 – 5875 MHz	50	500
24.0 – 24.25 GHz	250	2500

**Test Procedure:**

Measurements were performed with the EUT rotated 360 degrees and varying the adjustable antenna mast with 1 m to 4 m height to determine worst case orientation for maximum emissions. The antenna was placed 3m away from the EUT. The EUT was rotated about all three orthogonal axis.

**Test Results:**

The EUT is compliant with the requirements of § 15.249(a).

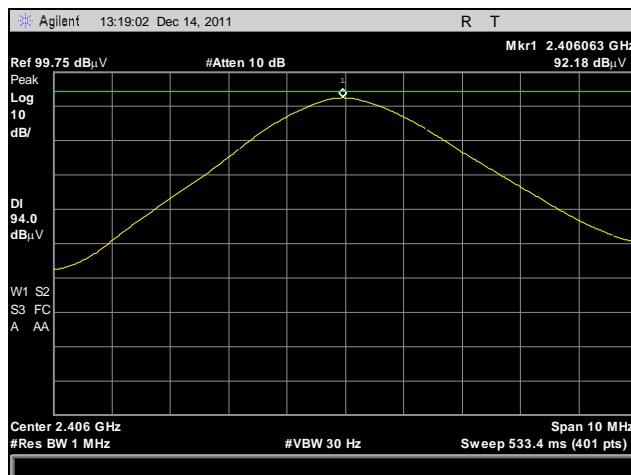
**Test Engineer(s):**

Ram Shrestha

**Test Date(s):**

12/16/11

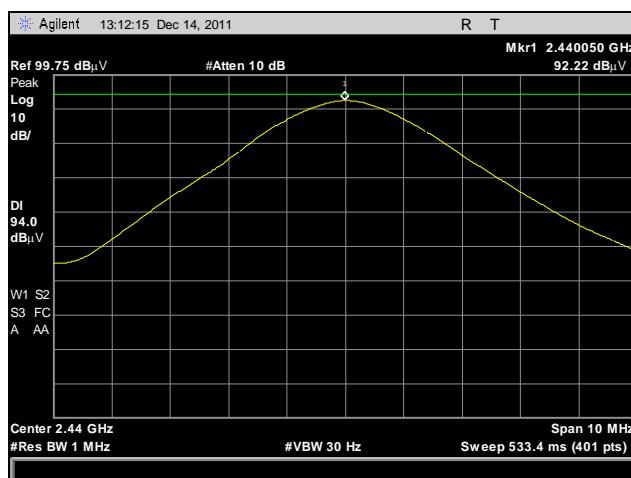
Channel	Frequency (MHz)	Measured Field Strength (dB $\mu$ V/m)		Limit (dB $\mu$ V/m)	
		Peak	Average	Peak	Average
Low	2406	101.1	92.18	114	94
Mid	2440	95.85	92.22	114	94
High	2474	94.26	90.69	114	94



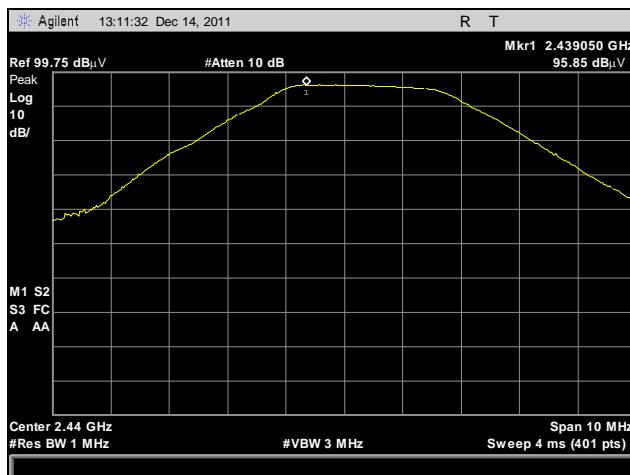
Plot 11. Field Strength of Fundamental, Low Channel, Average



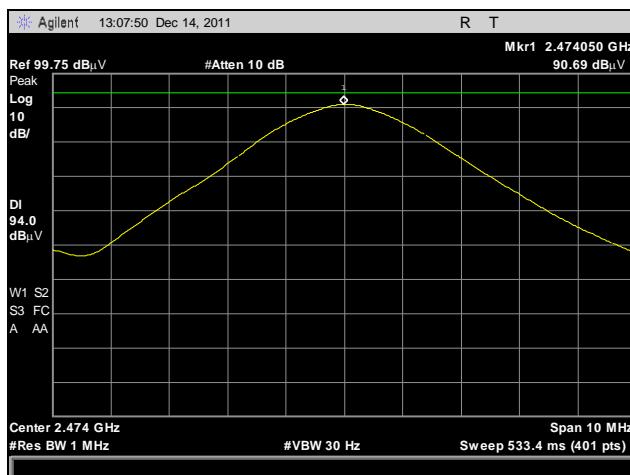
Plot 12. Field Strength of Fundamental, Low Channel, Peak Detector



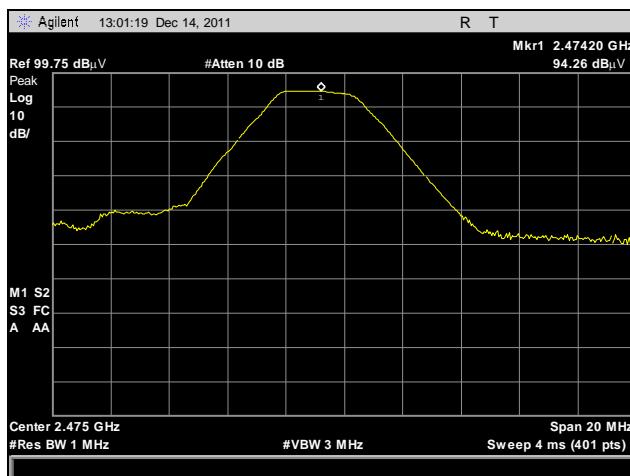
Plot 13. Field Strength of Fundamental, Mid Channel, Average



Plot 14. Field Strength of Fundamental, Mid Channel, Peak



Plot 15. Field Strength of Fundamental, High Channel, Average



Plot 16. Field Strength of Fundamental, High Channel, Peak

## Electromagnetic Compatibility Criteria for Intentional Radiators

### 20 dB and 99% Bandwidth

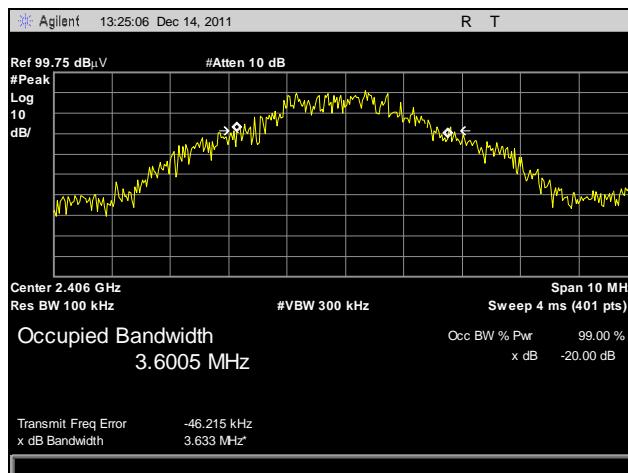
**Test Procedure:** The 20 dB and 99% Bandwidth was measured and recorded.

**Test Results:** See the following plots.

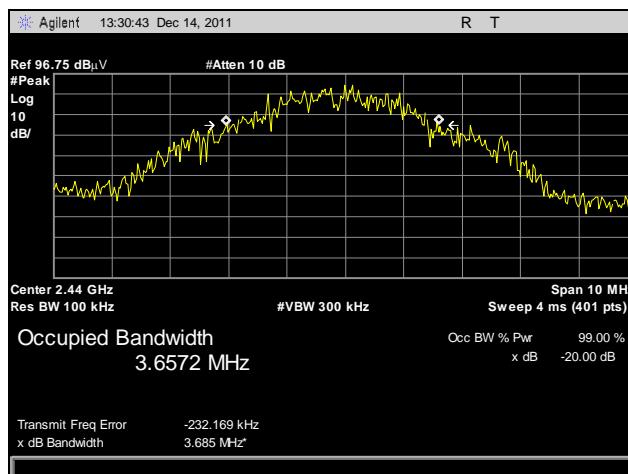
**Test Engineer(s):** Ram Shrestha

**Test Date(s):** 12/14/11

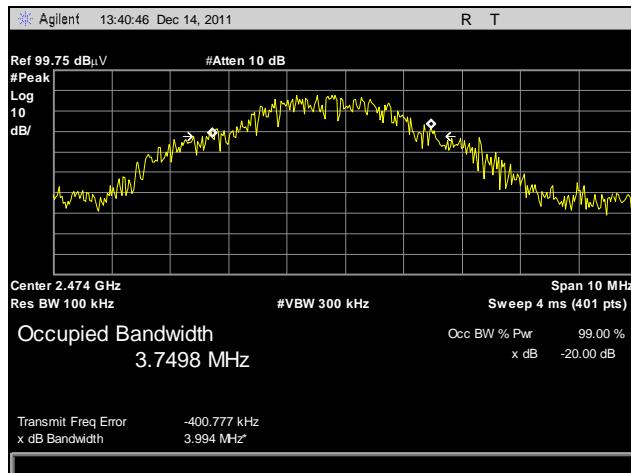
Channels	99%	-20dB BW
Low	3.4599	3.633
Mid	3.74	3.685
High	3.914	3.994



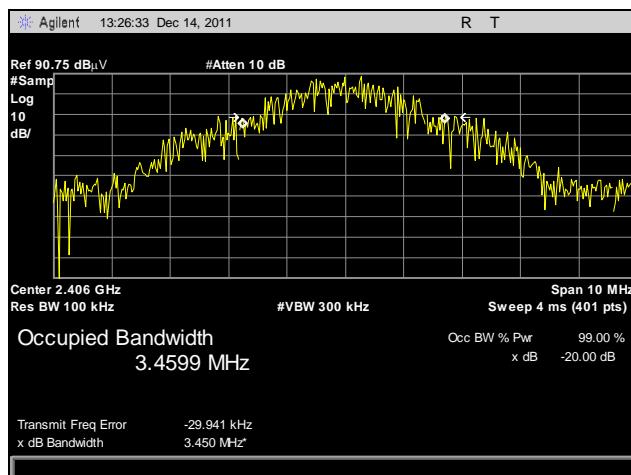
Plot 17. Occupied Bandwidth, Low Channel



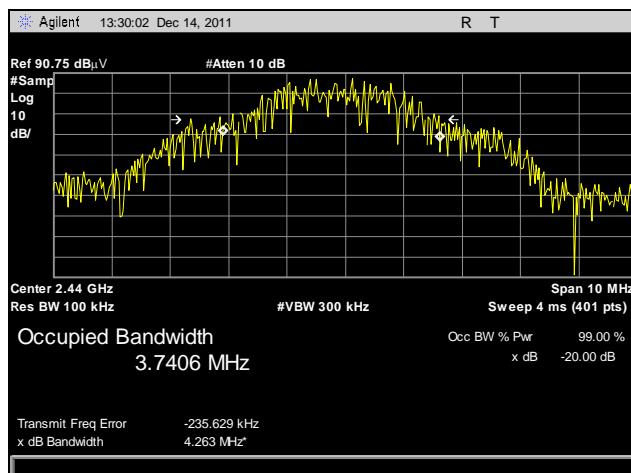
Plot 18. Occupied Bandwidth, Mid Channel



Plot 19. Occupied Bandwidth, High Channel



Plot 20. 99% Occupied Bandwidth, Low Channel



Plot 21. 99% Occupied Bandwidth, Mid Channel

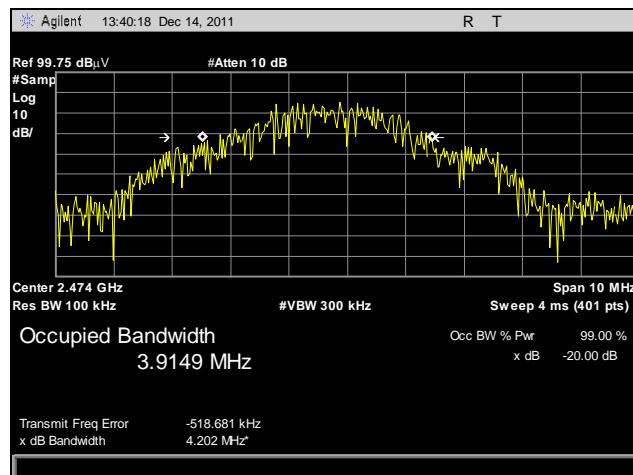


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**Plot 22. 99% Occupied Bandwidth, High Channel**



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## Electromagnetic Compatibility Criteria for Intentional Radiators

### § 15.249(a)(d) Harmonics and Spurious Emissions Requirements

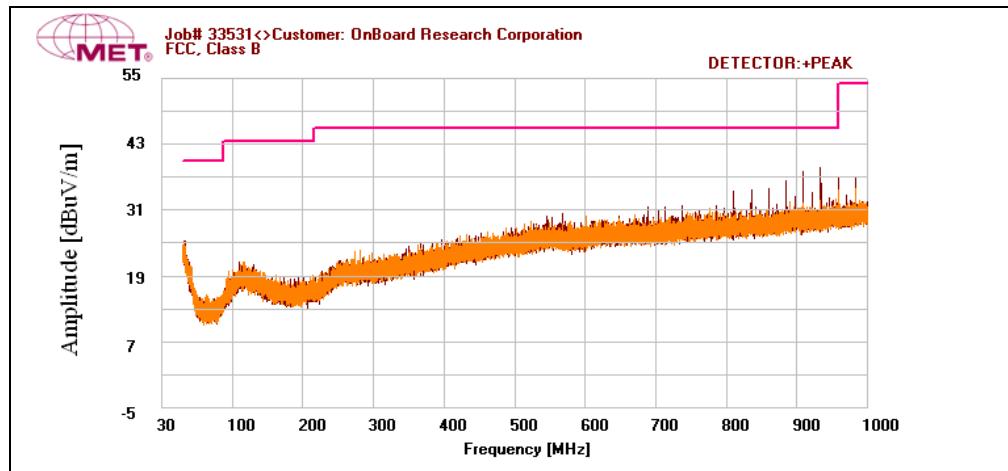
**Test Requirements:** Harmonics originating from devices that operate in the 2400 – 2483.5 MHz band shall meet the 500 microvolts/meter limit (i.e. 54 dBuV/m) with an average detector. In addition, emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 50 dB below the level of the fundamental or to the general radiated emission limits in §15.209, whichever is the lesser attenuation.

**Test Procedure:** Measurements were performed with the EUT rotated 360 degrees and varying the adjustable antenna mast with 1 m to 4 m height to determine worst case orientation for maximum emissions. Emissions below 1 GHz were performed with the antenna placed 10m away from EUT. For above 1 GHz, the measuring antenna was placed 3m away.

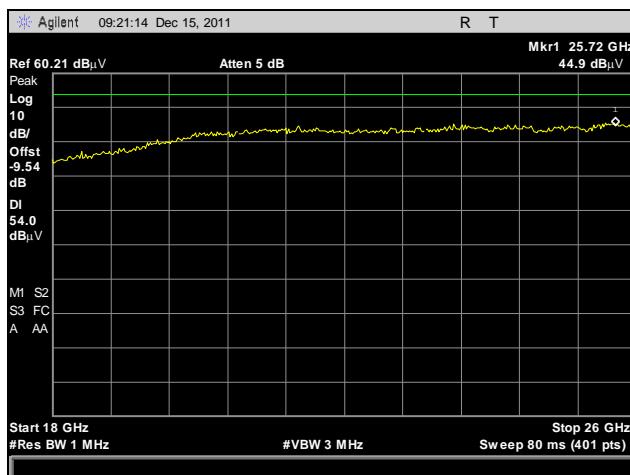
**Test Results:** The EUT is compliant with the harmonics and Spurious Emissions Requirements of §15.249(a)(d). For spurious emissions the lesser attenuation was the 15.209 limits.

**Test Technician/Engineer(s):** Allan Gazza and Ram Shrestha

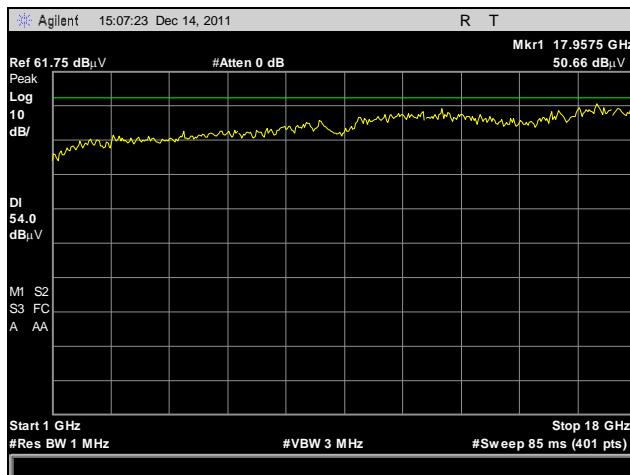
**Test Date(s):** 12/13/11 and 12/16/11



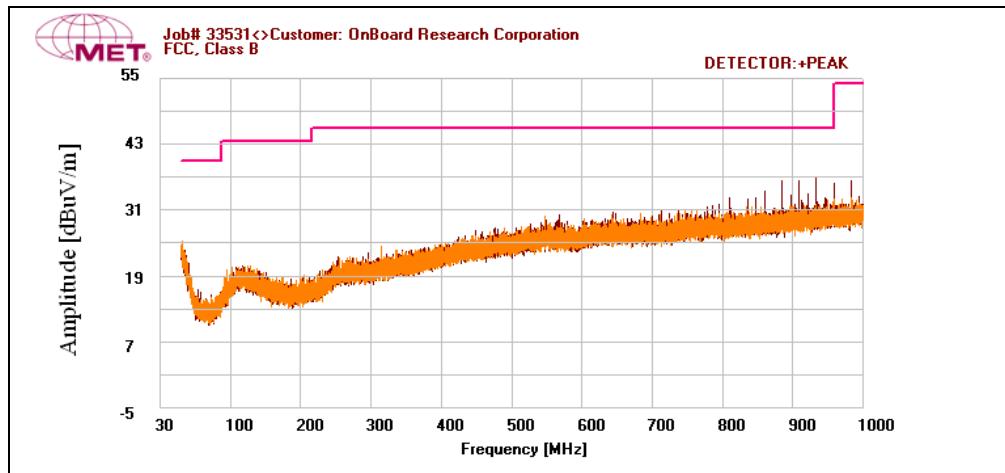
Plot 23. Radiated Spurious Emissions, Low Channel, 30 MHz – 1 GHz



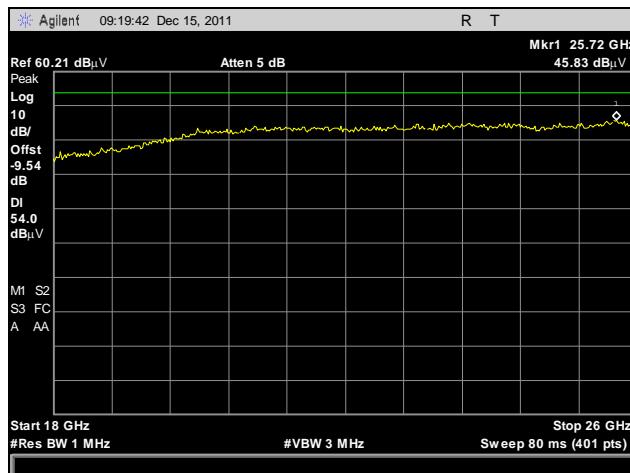
Plot 24. Radiated Spurious Emissions, Low Channel, 18 GHz – 26 GHz, Peak Detector, Average Limit



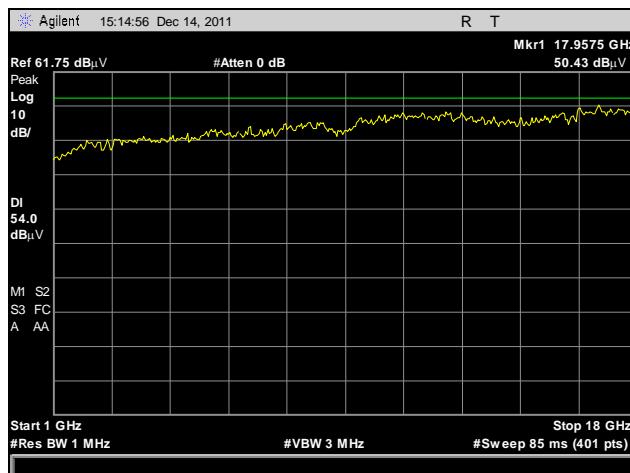
Plot 25. Radiated Spurious Emissions, Low Channel, 1-18GHz, Peak Detector, Average Limit



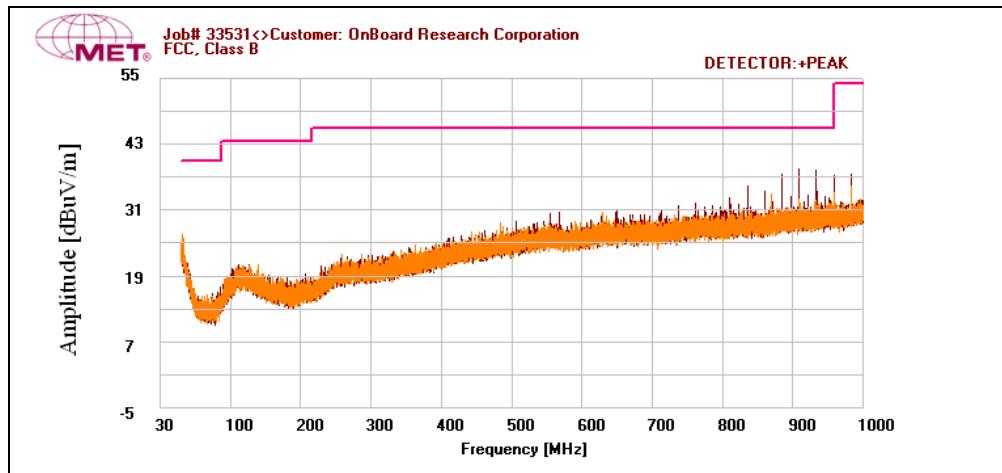
Plot 26. Radiated Spurious Emissions, Mid Channel, 30 MHz – 1 GHz, Peak Detector, Average Limit



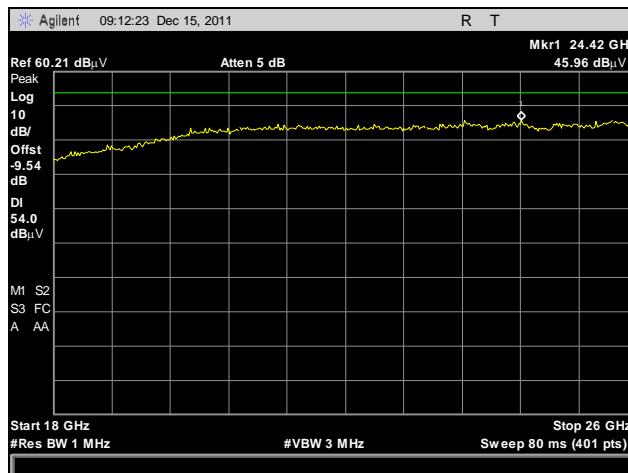
Plot 27. Radiated Spurious Emissions, Mid Channel, 18 GHz – 26 GHz, Peak Detector, Average Limit



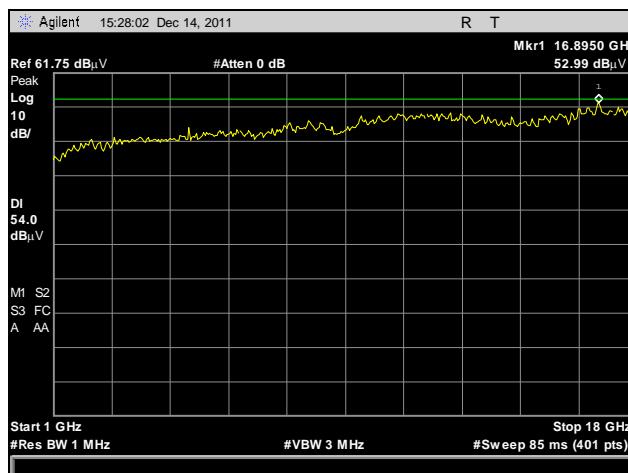
Plot 28. Radiated Spurious Emissions, Mid Channel, 1-18GHz, Peak Detector, Average Limit



**Plot 29. Radiated Spurious Emissions, High Channel, 30 MHz – 1 GHz, Peak Detector, Average Limit**



**Plot 30. Radiated Spurious Emissions, High Channel, 18 GHz – 26 GHz, Peak Detector, Average Limit**

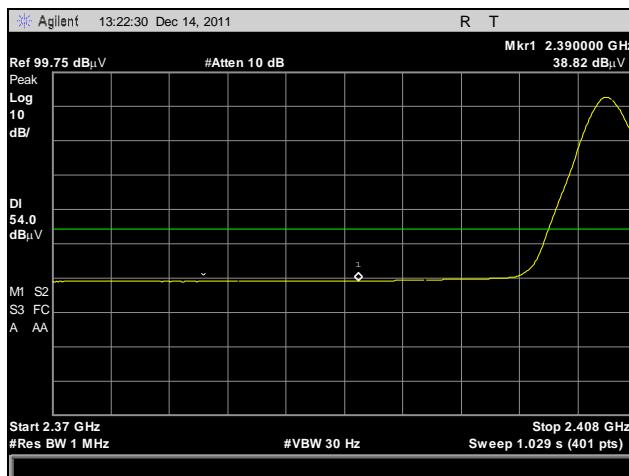


**Plot 31. Radiated Spurious Emissions, High Channel, 1-18GHz, Peak Detector, Average Limit**

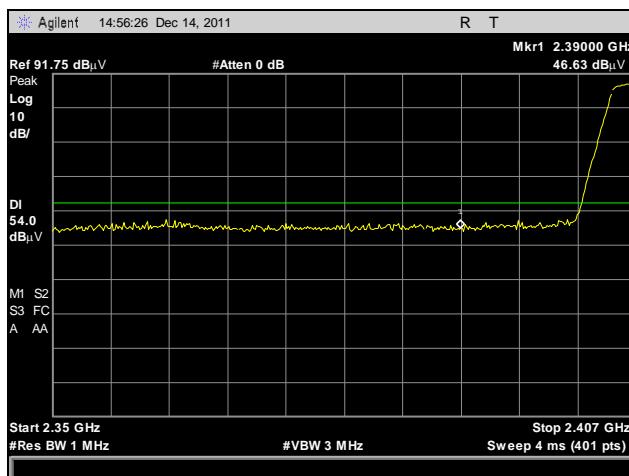
## Radiated Band Edge Measurements

### Test Procedures:

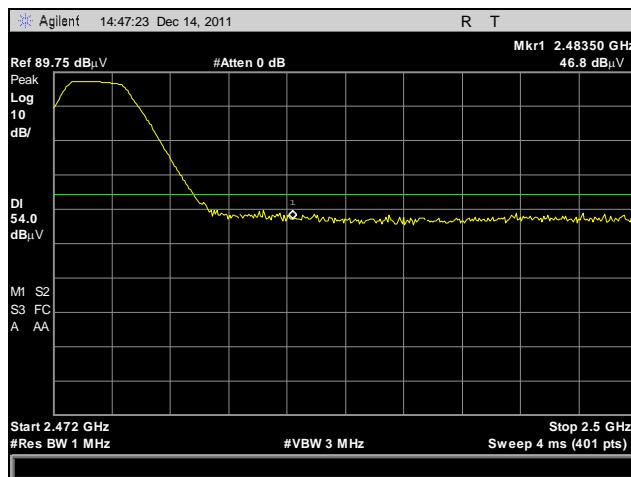
The transmitter was turned on. Measurements were performed of the low and high Channels. The EUT was rotated orthogonally through all three axes. Plots shown are corrected for both antenna correction factor and distance and compared to a 3 m limit line.



**Plot 32. Restricted Band Emissions, Low Channel, Average Detector, Average Limit**



**Plot 33. Restricted Band Emissions, Low Channel, Peak Detector, Average Limit**



**Plot 34. Restricted Band Emissions, High Channel, Peak Detector, Average Limit**

## Electromagnetic Compatibility Criteria for Intentional Radiators

### RSS-GEN      Receiver Spurious Emissions Requirements

**Test Requirements:** The following receiver spurious emission limits shall be complied with:

If a radiated measurement is made, all spurious emissions shall comply with the limits of Table 12.

Spurious Frequency (MHz)	Field Strength (microvolt/m at 3 metres)
30 – 88	100
88 – 216	150
216 – 960	200
Above 960	500

**Table 12. Spurious Emission Limits for Receivers**

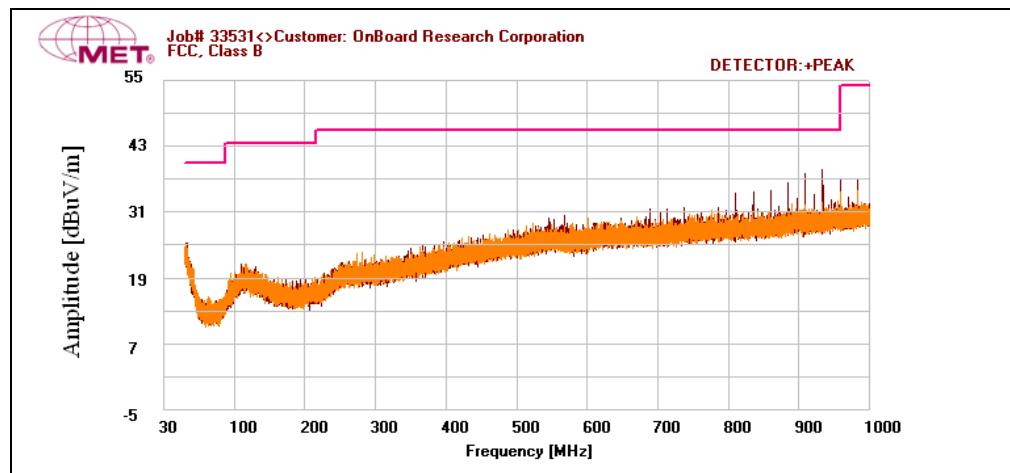
If a conducted measurement is made, receiver spurious emissions at any discrete frequency shall not exceed 2 nanowatts in the band 30 – 1000 MHz, and 5 nanowatts above 1000 MHz.

**Test Procedures:** The EUT has an integral antenna with no temporary antenna connectors. Testing was done radiated and the test limits of Table 12 were used.

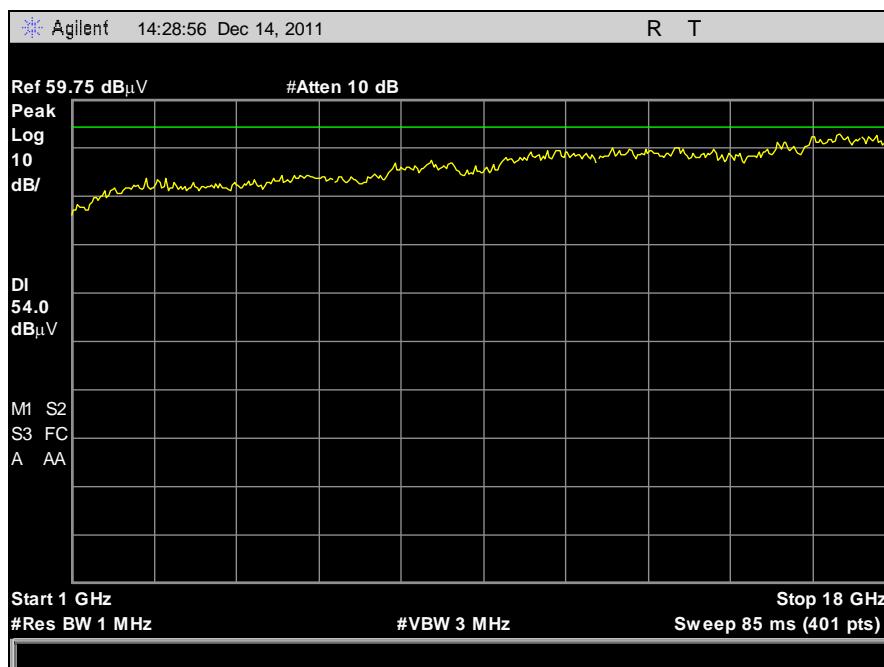
**Test Results:** Equipment is compliant with the Receiver Spurious Emissions Requirements of RSS-GEN.

**Test Engineer(s):** Ram Shrestha

**Test Date(s):** 12/14/11



Plot 35. Receiver Spurious Emission, 30 MHz – 1 GHz



Plot 36. Receiver Spurious Emission, 1 GHz – 18 GHz



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Electromagnetic Compatibility  
Test Equipment

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## IV. Test Equipment



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Test Equipment

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## Test Equipment

Calibrated test equipment utilized during testing was maintained in a current state of calibration per the requirements of ISO/IEC 17025:2005.

Test Name: Conducted Emissions ( Power)					Test Date(s): 12/15/2011
MET Asset #	Nomenclature	Manufacturer	Model	Last Cal Date	Cal Due Date
1A1065	EMI RECEIVER	ROHDE & SCHWARZ	ESCI	12/15/2010	1/15/2012
1A1087	ATTENUATOR	ROHDE & SCHWARZ	ESH3Z2	3/11/2011	3/11/2012
1A1021	VOLTAGE DISPLAY	NEWPORT	Q9000-FUR6	9/15/2010	3/15/2012
1A1076	POWER TRANSFORMER	SUPERIOR ELECTRIC	POWERSTAT	SEE NOTE	
1A1019	ESH3-25 LISN (AE)	ROHDE & SCHWARZ	831-5518.2	SEE NOTE	
1A1119	TEST AREA	CUSTOM MADE	N/A	3/28/2011	3/28/2012
1A1122	LISN	TESEQ	NNB 51	3/31/2011	3/31/2012

Test Name: Radiated Emissions					Test Date(s): 12/14/2011, 12/15/2011
MET Asset #	Nomenclature	Manufacturer	Model	Last Cal Date	Cal Due Date
1A1083	EMI TEST RECEIVER	ROHDE & SCHWARZ	ESU40	2/22/2011	2/22/2012
1A1088	PRE-AMP	RHODE & SCHWARZ	TS-PR1	5/2/2011	5/2/2012
1A1113	PRE-AMP	MINI-CIRCUIT	ZVA-183+	4/4/2011	4/4/2012
1A1072	PRE-AMP	miteq	AFS5-01001800-25-8P-6-PS	4/4/2011	4/4/2012
1A1090	PRE-AMP	miteq	AFS44-00182650-42-10P-44	4/4/2011	4/4/2012
1A1047	HORN ANTENNA	ETS	3117	7/28/2010	1/28/2012
1A1026	18-26.5GHZ ANTENNA	ETS	011777-002	4/23/2010	4/23/2012
1A1050	BI-CONILOG ANTENNA (30MHZ TO 1GHZ)	SCHAFFNER	CBL6112D	4/22/2011	4/22/2012
1A1106	10M CHAMBER	ETS	SEMI-ANECHOIC	9/12/2011	9/12/2012
1S2607	SPECTRUM ANALYZER	AGILENT	E4407B	08/09/2011	08/09/2012

Note: Functionally tested equipment is verified using calibrated instrumentation at the time of testing.



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Electromagnetic Compatibility  
Certification & User's Manual Information  
CFR Title 47, Part 15B, 15.249; RSS-210, Issue 8, December 2010 & ICES-003

## V. Certification & User's Manual Information



## Certification & User's Manual Information

### A. Certification Information

The following is extracted from Title 47 of the Code of Federal Regulations, Part 2, Subpart I — Marketing of Radio frequency devices:

#### § 2.801 Radio-frequency device defined.

As used in this part, a radio-frequency device is any device which in its operation is capable of emitting radio-frequency energy by radiation, conduction, or other means. Radio-frequency devices include, but are not limited to:

- (a) The various types of radio communication transmitting devices described throughout this chapter.
- (b) *The incidental, unintentional and intentional radiators defined in Part 15 of this chapter.*
- (c) The industrial, scientific, and medical equipment described in Part 18 of this chapter.
- (d) Any part or component thereof which in use emits radio-frequency energy by radiation, conduction, or other means.

#### § 2.803 Marketing of radio frequency devices prior to equipment authorization.

- (a) Except as provided elsewhere in this chapter, no person shall sell or lease, or offer for sale or lease (including advertising for sale or lease), or import, ship or distribute for the purpose of selling or leasing or offering for sale or lease, any radio frequency device unless:
  - (1) In the case of a device subject to certification, such device has been authorized by the Commission in accordance with the rules in this chapter and is properly identified and labeled as required by §2.925 and other relevant sections in this chapter; or
  - (2) In the case of a device that is not required to have a grant of equipment authorization issued by the Commission, but which must comply with the specified technical standards prior to use, such device also complies with all applicable administrative (including verification of the equipment or authorization under a Declaration of Conformity, where required), technical, labeling and identification requirements specified in this chapter.
- (d) Notwithstanding the provisions of paragraph (a) of this section, the offer for sale solely to business, commercial, industrial, scientific or medical users (but not an offer for sale to other parties or to end users located in a residential environment) of a radio frequency device that is in the conceptual, developmental, design or pre-production stage is permitted prior to equipment authorization or, for devices not subject to the equipment authorization requirements, prior to a determination of compliance with the applicable technical requirements *provided* that the prospective buyer is advised in writing at the time of the offer for sale that the equipment is subject to the FCC rules and that the equipment will comply with the appropriate rules before delivery to the buyer or to centers of distribution.



(e)(1) Notwithstanding the provisions of paragraph (a) of this section, prior to equipment authorization or determination of compliance with the applicable technical requirements any radio frequency device may be operated, but not marketed, for the following purposes and under the following conditions:

- (i) *Compliance testing;*
- (ii) Demonstrations at a trade show provided the notice contained in paragraph (c) of this section is displayed in a conspicuous location on, or immediately adjacent to, the device;
- (iii) Demonstrations at an exhibition conducted at a business, commercial, industrial, scientific or medical location, but excluding locations in a residential environment, provided the notice contained in paragraphs (c) or (d) of this section, as appropriate, is displayed in a conspicuous location on, or immediately adjacent to, the device;
- (iv) Evaluation of product performance and determination of customer acceptability, provided such operation takes place at the manufacturer's facilities during developmental, design or pre-production stages; or
- (v) Evaluation of product performance and determination of customer acceptability where customer acceptability of a radio frequency device cannot be determined at the manufacturer's facilities because of size or unique capability of the device, provided the device is operated at a business, commercial, industrial, scientific or medical user's site, but not at a residential site, during the development, design or pre-production stages.

(e)(2) For the purpose of paragraphs (e)(1)(iv) and (e)(1)(v) of this section, the term *manufacturer's facilities* includes the facilities of the party responsible for compliance with the regulations and the manufacturer's premises, as well as the facilities of other entities working under the authorization of the responsible party in connection with the development and manufacture, but not the marketing, of the equipment.

(f) For radio frequency devices subject to verification and sold solely to business, commercial, industrial, scientific and medical users (excluding products sold to other parties or for operation in a residential environment), parties responsible for verification of the devices shall have the option of ensuring compliance with the applicable technical specifications of this chapter at each end user's location after installation, provided that the purchase or lease agreement includes a proviso that such a determination of compliance be made and is the responsibility of the party responsible for verification of the equipment.



## Certification & User's Manual Information

The following is extracted from Title 47 of the Code of Federal Regulations, Part 2, Subpart J — Equipment Authorization Procedures:

### § 2.901 Basis and Purpose

- (a) In order to carry out its responsibilities under the Communications Act and the various treaties and international regulations, and in order to promote efficient use of the radio spectrum, the Commission has developed technical standards for radio frequency equipment and parts or components thereof. The technical standards applicable to individual types of equipment are found in that part of the rules governing the service wherein the equipment is to be operated.<sup>1</sup> *In addition to the technical standards provided, the rules governing the service may require that such equipment be verified by the manufacturer or importer,* be authorized under a Declaration of Conformity, or receive an equipment authorization from the Commission by one of the following procedures: certification or registration.
- (b) The following sections describe the verification procedure, the procedure for a Declaration of Conformity, and the procedures to be followed in obtaining certification from the Commission and the conditions attendant to such a grant.

### § 2.907 Certification.

- (a) Certification is an equipment authorization issued by the Commission, based on representation and test data submitted by the applicant.
- (b) Certification attaches to all units subsequently marketed by the grantee which are identical (see Section 2.908) to the sample tested except for permissive changes or other variations authorized by the Commission pursuant to Section 2.1043.

<sup>1</sup> In this case, the equipment is subject to the rules of Part 15. More specifically, the equipment falls under Subpart B (of Part 15), which deals with unintentional radiators.



## Certification & User's Manual Information

### § 2.948 Description of measurement facilities.

- (a) Each party making measurements of equipment that is subject to an equipment authorization under Part 15 or Part 18 of this chapter, regardless of whether the measurements are filed with the Commission or kept on file by the party responsible for compliance of equipment marketed within the U.S. or its possessions, shall compile a description of the measurement facilities employed.
  - (1) If the measured equipment is subject to the verification procedure, the description of the measurement facilities shall be retained by the party responsible for verification of the equipment.
    - (i) *If the equipment is verified through measurements performed by an independent laboratory, it is acceptable for the party responsible for verification of the equipment to rely upon the description of the measurement facilities retained by or placed on file with the Commission by that laboratory. In this situation, the party responsible for the verification of the equipment is not required to retain a duplicate copy of the description of the measurement facilities.*
    - (ii) If the equipment is verified based on measurements performed at the installation site of the equipment, no specific site calibration data is required. It is acceptable to retain the description of the measurement facilities at the site at which the measurements were performed.
  - (2) If the equipment is to be authorized by the Commission under the certification procedure, the description of the measurement facilities shall be filed with the Commission's Laboratory in Columbia, Maryland. The data describing the measurement facilities need only be filed once but must be updated as changes are made to the measurement facilities or as otherwise described in this section. At least every three years, the organization responsible for filing the data with the Commission shall certify that the data on file is current.



## Certification & User's Manual Information

### Label and User's Manual Information

The following is extracted from Title 47 of the Code of Federal Regulations, Part 15, Subpart A — General:

#### § 15.19 Labeling requirements.

(a) *In addition to the requirements in Part 2 of this chapter, a device subject to certification or verification shall be labeled as follows:*

(1) Receivers associated with the operation of a licensed radio service, e.g., FM broadcast under Part 73 of this chapter, land mobile operation under Part 90, etc., shall bear the following statement in a conspicuous location on the device:

This device complies with Part 15 of the FCC Rules. Operation is subject to the condition that this device does not cause harmful interference.

(2) A stand-alone cable input selector switch, shall bear the following statement in a conspicuous location on the device:

This device is verified to comply with Part 15 of the FCC Rules for use with cable television service.

(3) All other devices shall bear the following statement in a conspicuous location on the device:

*This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.*

(4) Where a device is constructed in two or more sections connected by wires and marketed together, the statement specified under paragraph (a) of this section is required to be affixed only to the main control unit.

(5) When the device is so small or for such use that it is not practicable to place the statement specified under paragraph (a) of this section on it, the information required by this paragraph shall be placed in a prominent location in the instruction manual or pamphlet supplied to the user or, alternatively, shall be placed on the container in which the device is marketed. However, the FCC identifier or the unique identifier, as appropriate, must be displayed on the device.

#### § 15.21 Information to user.

The users manual or instruction manual for an intentional or unintentional radiator shall caution the user that changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.



## Verification & User's Manual Information

The following is extracted from Title 47 of the Code of Federal Regulations, Part 15, Subpart B — Unintentional Radiators:

### § 15.105 Information to the user.

(a) For a Class A digital device or peripheral, the instructions furnished the user shall include the following or similar statement, placed in a prominent location in the text of the manual:

Note: This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at own expense.

(b) For a Class B digital device or peripheral, the instructions furnished the user shall include the following or similar statement, placed in a prominent location in the text of the manual:

Note: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a residential environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.



## ICES-003 Procedural & Labeling Requirements

From the Industry Canada Electromagnetic Compatibility Advisory Bulletin entitled, "Implementation and Interpretation of the Interference-Causing Equipment Standard for Digital Apparatus, ICES-003" (EMCAB-3, Issue 2, July 1995):

"At present, CISPR 22: 2002 and ICES technical requirements are essentially equivalent. Therefore, if you have CISPR 22: 2002 approval by meeting CISPR Publication 22, the only additional requirements are: to attach a note to the report of the test results for compliance, indicating that these results are deemed satisfactory evidence of compliance with ICES-003 of the Canadian Interference-Causing Equipment Regulations; to maintain these records on file for the requisite five year period; and to provide the device with a notice of compliance in accordance with ICES-003."

### Procedural Requirements:

According to Industry Canada's Interference Causing Equipment Standard for Digital Apparatus ICES-003 Issue 4, February 2004:

Section 6.1: A record of the measurements and results, showing the date that the measurements were completed, shall be retained by the manufacturer or importer for a period of at least five years from the date shown in the record and made available for examination on the request of the Minister.

Section 6.2: A written notice indicating compliance must accompany each unit of digital apparatus to the end user. The notice shall be in the form of a label that is affixed to the apparatus. Where because of insufficient space or other constraints it is not feasible to affix a label to the apparatus, the notice may be in the form of a statement in the user's manual.

### Labeling Requirements:

The suggested text for the notice, in English and in French, is provided below, from the Annex of ICES-003:

This Class <sup>2</sup>] digital apparatus complies with Canadian ICES-003.

Cet appareil numérique de la classe <sup>1</sup>] est conforme à la norme NMB-003 du Canada.

<sup>2</sup> Insert either A or B but not both as appropriate for the equipment requirements.



OnBoard Research Corp.  
Intellitouch Freedom One, Base Unit Model #WT1P

Electromagnetic Compatibility  
End of Report

CFR Title 47, Part 15B, 15.249; RSS-210, Issue 8, December 2010 & ICES-003

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## End of Report